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# ESSAYS,

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By BENJAMIN COUNT OF RUMFORD,

*H. i. g.*

KNIGHT OF THE ORDERS OF THE WHITE EAGLE, AND ST. STANISLAUS;

Chamberlain, Privy Counsellor of State, and Lieutenant-General in the Service

of his Most Serene Highness the ELECTOR PALATINE Reigning DUKE

of BAVARIA; Colonel of his Regiment of Artillery, and Commander in

Chief of the General Staff of his Army; F. R. S. Acad. R.

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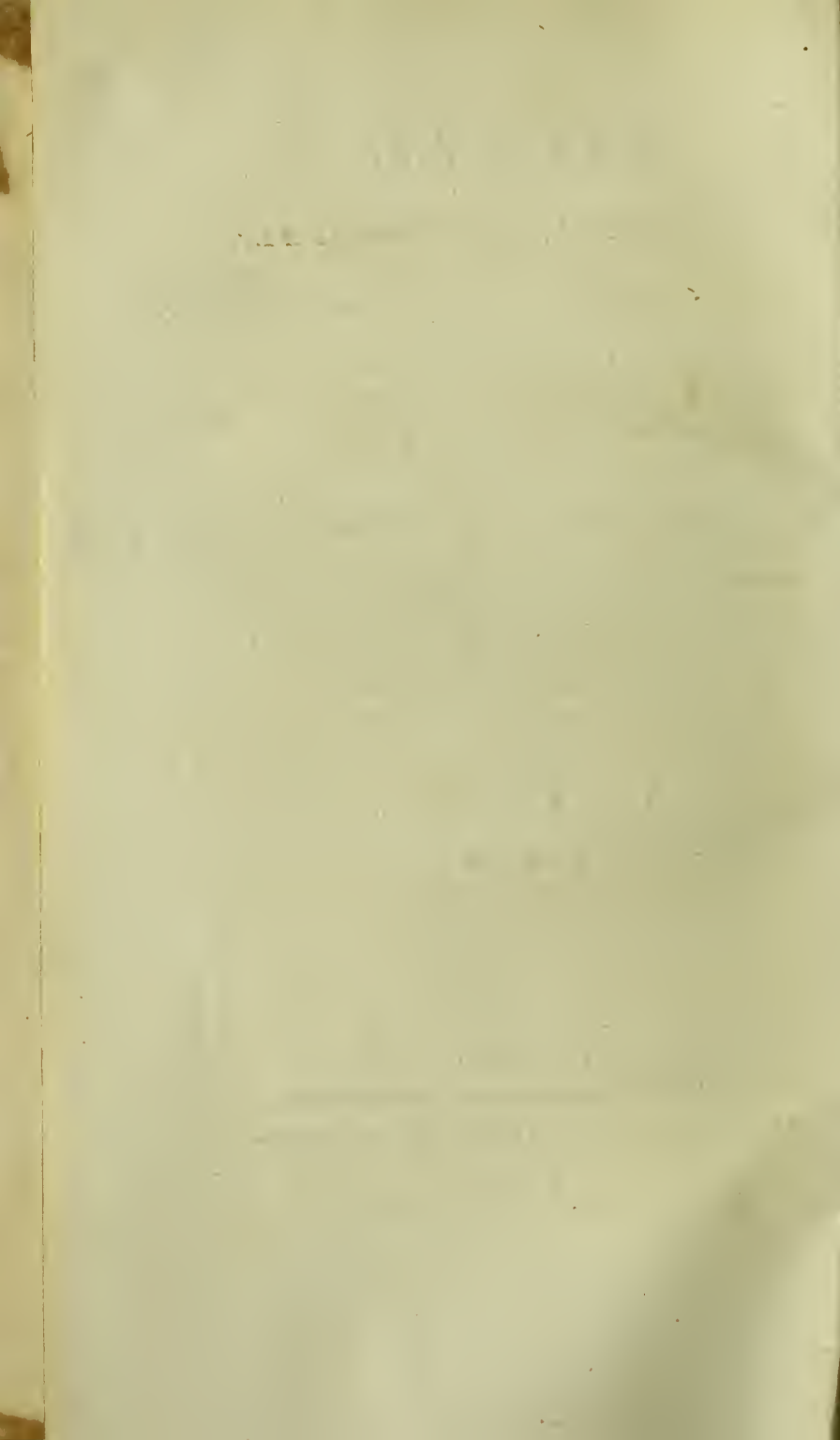
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## ADVERTISEMENT.

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**A**LMOST four years have elapsed since this Essay was announced to the Public, and although a considerable part of the Manuscript was then ready, yet, from a variety of considerations, I have been induced to defer sending it to the press; and even now the First Part only of the Essay is laid before the Public.

Among the motives which have operated most powerfully to induce me to postpone the publication of this work was a desire to make it as free of faults as possible, and to accommodate it as much as possible to the actual state of opinions and practices in this country.

In proportion as my exertions to promote useful improvements have been favourably received by the Public, and my writings have obtained an extensive circulation, my anxiety has been increased to deserve that confidence which is essential to my success. I feel it to be more and more my duty to proceed slowly, and to use every precaution in investigating the subjects I have undertaken to treat, and in explaining what I recommend, in order that others may not be led into errors, either by mistakes in principle, or inaccuracy in description.

I have, indeed, of late seen but too many proofs of the necessity of adopting this cautious method of proceeding.

On my return to England from Bavaria last autumn (1798), after an absence of two years, I was not a little gratified to learn, that several improvements recommended in my Essays, and particularly the alterations in the construction of Chimney Fire-places, that were proposed in my Fourth Essay, had been adopted in many places; and that they had in general been found to answer very well; but the satisfaction which this information naturally afforded me, has since been,—I believe I may say,—more than counterbalanced by the pain I have experienced on discovering, on a nearer examination, the numerous mistakes that have been committed by those who have undertaken to put my plans in execution:—not to mention the unjustifiable use that has in some instances been made of my name, in bringing forward for sale inventions which I never recommended, and of which I never can approve without abandoning all the fundamental principles relative to the combustion of fuel, and the management and direction of heat, which, after a long and patient investigation, I have been induced to adopt.

It would be foolish for me to imagine, and ridiculous to pretend, that the plans I have proposed are so perfect as to be incapable of farther improvement. I am far, very far, from being of that opinion, and I can say with truth, that I shall at  
all

all times rejoice when farther improvements are made in them ; but still I may be permitted to add, that it would be a great satisfaction to me if those, who, from an opinion of their utility, or from a desire to give the experiment a fair trial, should be disposed to adopt any of the plans I have recommended, would take the trouble to examine whether the workmen they employ really understand, and are disposed to follow the directions I have given,—or whether they are not, perhaps, prepossessed with some favourite contrivance and imaginary improvement of their own,—or whether there is no danger of their introducing alterations for the purpose of enhancing the price of their work,—or of the articles they furnish.

These are dangers of which those who have the smallest acquaintance with mankind, must be perfectly sensible ; and it would be unwise, and I had almost said unjust, not to attend to them, at least to a certain degree.

All I ask is, that a *fair trial* may be given to the plans I propose, when *any* trial is given them ; and this request will not, I trust, be thought unreasonable : and as I never presume to recommend to the Public any new invention or improvement that I have not previously and repeatedly tried, and found *by experience* to be useful, it would perhaps be thought excusable were I to express a wish that my proposals might not be condemned nor neglected merely in consequence of the failure of contrivances announced as *improvements* of my Plans.



The reader will not be surprized at my extreme anxiety to remove those obstacles which appear to me most powerfully to obstruct and retard the general introduction of the improvements I am labouring to introduce ; for anxiety for the success of an undertaking naturally flows from a conviction of its importance, and is always connected with that fervent zeal which important undertakings are so eminently calculated to inspire.

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To this Second Edition of the First Part of my Tenth Essay, I beg leave to add a few words respecting the SOUP ESTABLISHMENTS that have lately been formed in London, and in other places, for feeding the Poor.

Many persons in this country are of opinion that a great deal of meat is necessary in order to make a good and wholesome soup ; but this is far from being the case in fact. Some of the most savoury and most nourishing soups are made without any meat ; and in providing food for the poor it is necessary, on many accounts, to be very sparing in the use of it.

When the poor are fed from a Public Kitchen, care should be taken to supply them with the cheapest kinds of food, and particularly with such as they can afterwards provide for themselves, at their own dwellings, at a small expence ; otherwise the temporary relief that is afforded them in times  
of

of scarcity, by selling to them rich and expensive meat soups at reduced prices, will operate as a great and a permanent evil to themselves and to society.

The most palatable and the most nourishing soups may, with a little care and ingenuity, be composed with very cheap materials, as has been proved of late by a great number of decisive experiments made upon a large scale in different countries. The Soup Establishments that have been formed at Hamburgh,—at Geneva,—at Lausanne, and other parts of Switzerland,—at Marseilles, and lately at Paris, have all succeeded; and at most of these places the kind of soup that was provided for the poor at Munich has been adopted, with but little variation.—In some cases a small quantity of salt meat has been used, but this has been merely as a seasoning: the basis of these soups has uniformly been barley, potatoes, and peas or beans; and a small quantity of bread has in all cases been added to the soup when it has been served out.

No ingredient is, in my opinion, so indispensably necessary in the soups that are furnished to the poor as *bread*; it should never be omitted, and certainly not in times of scarcity; because there is no way in which bread will go so far as when it is eaten in soups: for every ounce so used, I am confident that four ounces that would otherwise be eaten by the poor at their homes, would be saved. And to this we may add, that oaten cakes, and other bread of inferior quality, will answer very well in soups, particularly

ticularly if it be toasted or fried, and broken or cut into small pieces. If the soup be well seasoned, its taste will predominate, and the taste peculiar to the bread will not be perceived.

A great variety of the most agreeable tastes may be given to soups, at a very small expence; and if bread be mixed with the soup, mastication will be rendered necessary, and the pleasure that is enjoyed in eating a good meal of it will be greatly prolonged and increased.

It is by no means surprizing that prejudices should be strong against soups, in those countries where soups and broths are considered as being merely thin wash without taste or substance, a pint of which might as easily be swallowed down at a breath as so much water; but these prejudices will vanish when the false impressions which gave rise to them are removed.

Soups may, it is true, be made thick and substantial with meat; but when this is done, they are neither palatable nor wholesome: they appal and load the stomach,—weaken the powers of digestion,—and instead of affording wholesome nourishment, strength, and refreshment, are the cause of many disorders; they are moreover very expensive. But this is not the case with soups made thick and substantial with farinacious matter, and other vegetable substances, and seasoned and rendered palatable with salt, pepper, onions, and a little salted herrings, hung beef, bacon, or cheese, and eaten with a due proportion of bread.

I am

I am the more anxious to recal the attention of the Public to this subject at the present time, as the utility of the Public Kitchens for feeding the Poor, which have lately been formed and are now forming in various parts of the kingdom, must depend very much on the choice of the ingredients used in preparing food, and the manner of combining them, which is adopted by those who have the direction of these interesting establishments. The share I have had in bringing these establishments into use,—the opinion I entertain of their importance to society,—and the anxiety I must naturally feel for their success,—will, I flatter myself, be considered as a sufficient excuse for my solicitude in watching over their progress, and for the liberty I may take in pointing out any mistakes in the management of them that might tend to bring them into disrepute.





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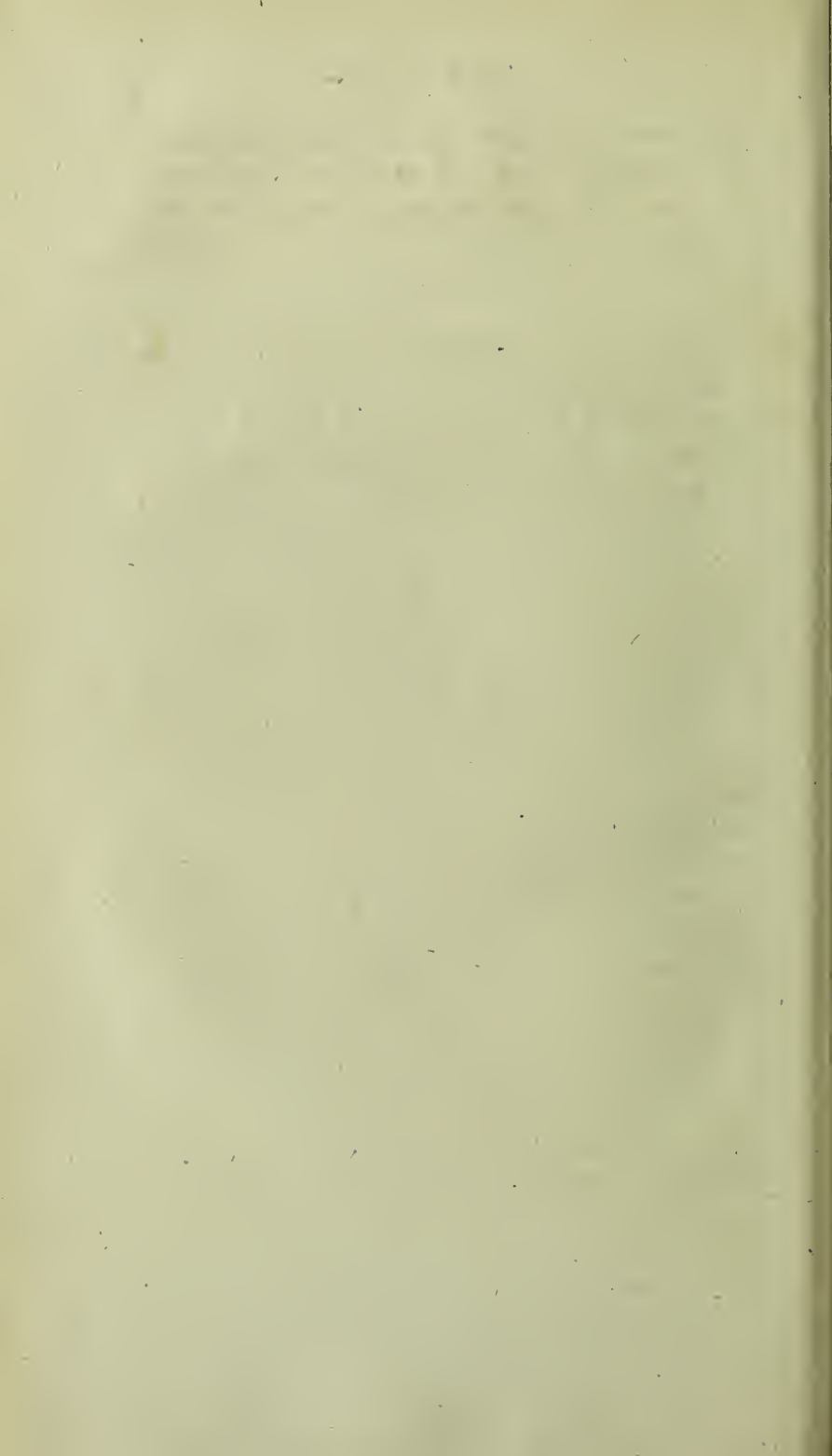
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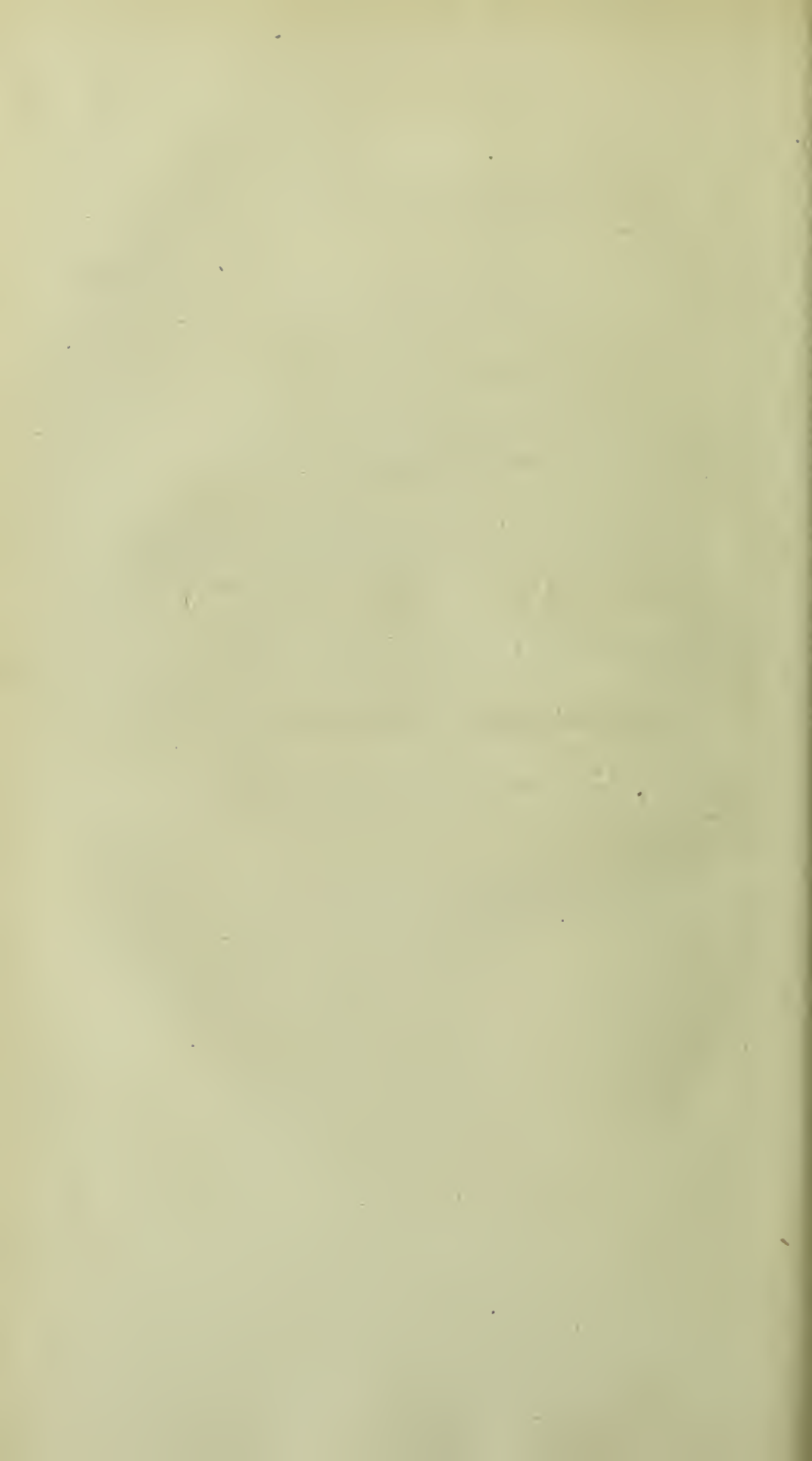
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ESSAY X.

ON THE

CONSTRUCTION OF KITCHEN FIRE-PLACES

AND

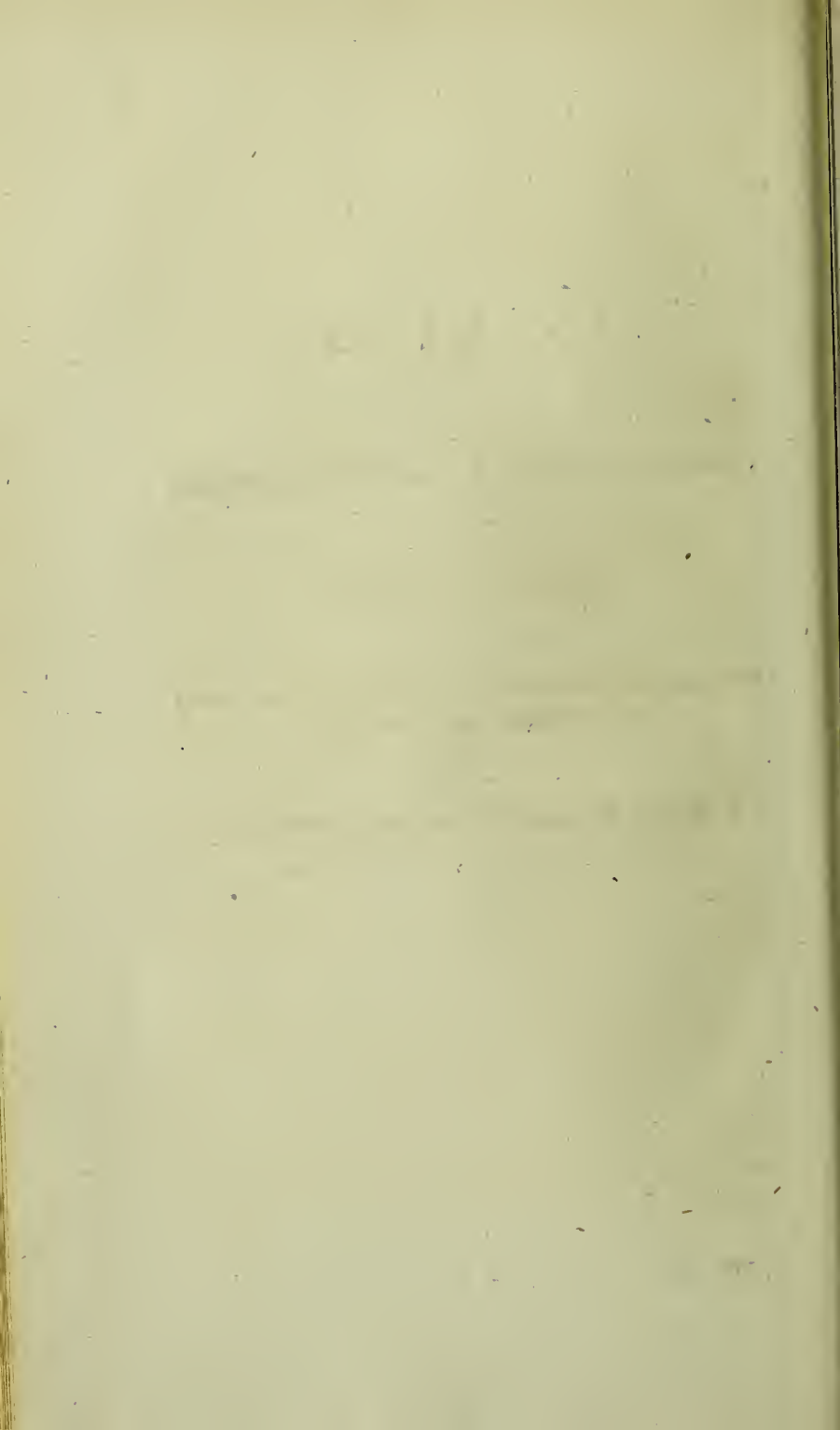
KITCHEN UTENSILS,

TOGETHER WITH

REMARKS and OBSERVATIONS relating to the various  
*PROCESSES OF COOKERY;*

AND

PROPOSALS for improving that MOST USEFUL ART.



## ESSAY X.

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### INTRODUCTION.

**I**N contriving machinery for any purpose, it is indispensably necessary to be acquainted with the nature of the mechanical operation to be performed ; and though the Processes of Cookery appear to be so simple and easy to be understood, that any attempt to explain and illustrate them might perhaps be thought not only superfluous but even frivolous, yet when we examine the matter attentively, we shall find their investigation to be of serious importance.—I say of *serious* importance, for surely those inquiries which lead to improvements by which the providing of *food* may be facilitated, are matters of the highest concern to mankind, in every state of society.

The process by which food is most commonly prepared for the table,—BOILING,—is so familiar to every one, and its effects are so uniform, and apparently so simple, that few, I believe, have taken the trouble to inquire *how*, or in *what manner*, those effects are produced ; and whether any, and what improvements in that branch of cookery are possible.

possible. So little has this matter been an object of inquiry, that few, very few indeed, I believe, among the *millions of persons* who for so many ages have been *daily* employed in this process, have ever given themselves the trouble to bestow one serious thought on the subject.

The cook knows *from experience*, that if his joint of meat be kept a certain time immersed in boiling water, it will be *done*, as it is called in the language of the kitchen; but if he be asked *what* is done to it?—or *how*, or *by what agency* the change it has undergone has been effected?—if he understands the question,—it is ten to one but he will be embarrassed:—if he does not understand it, he will probably answer without hesitation, that “*the meat is made tender and eatable by being boiled.*”—Ask him if the boiling of the water be essential to the success of the process?—He will answer, “*without doubt.*” Push him a little farther by asking him, whether, *were it possible* to keep the water *equally hot* without boiling, the meat would not be cooked *as soon*, and *as well*, as if the water were made to boil? Here it is probable that he will make the first step towards acquiring knowledge, *by learning to doubt.*

When you have brought him to see the matter in its true light, and to confess that *in this view of it* the subject is new to him, you may then venture to tell him, (and to prove to him, if you happen to have a thermometer at hand,) that water which *just boils* is as hot as it can possibly be made *in an open vessel.*—That all the fuel which is used in making it  
boil



boil with violence is wasted, without adding a single degree to the heat of the water, or expediting or shortening the process of cooking a single instant.—That it is by *the heat*,—its *intensity*, and the *time of its duration*, that the food is cooked,—and not by the *boiling* or *ebullition*,—or bubbling up of the water ; which has *no part whatever* in that operation.

Should any doubts still remain in his mind with respect to the inefficacy and inutility of boiling, in culinary processes, where *the same degree of heat* may be had, and be *kept up* without it, let a piece of meat be cooked in a Papin's digester, which, as is well known, is a boiler whose cover (which is fastened down with screws) shuts with so much nicety that no steam can escape out of it. In such a *closed* vessel, boiling (which is nothing else but the escape of steam in bubbles from the hot liquid) is absolutely impossible ; yet, if the heat applied to the digester be such as would cause an equal quantity of water in an open vessel to boil, the meat will not only be *done*, but it will be found to be dressed in a shorter time, and to be much tenderer than if it had been boiled in an open boiler. By applying a still greater degree of heat to the digester, the meat may be so much done in a very few minutes as actually to fall to pieces ; and even the very bones may be made soft.

Were it a question of mere idle curiosity, whether it be the *boiling* of water, or simply the *degree of heat* which exists in boiling water, by which

food is cooked, it would doubtless be folly to throw away time in its investigation; but this is far from being the case, for *boiling* cannot be carried on without a very great expence of fuel; but any boiling-hot liquid (by using proper means for confining the heat) may be kept *boiling-hot* for any length of time almost without any expence of fuel at all.

The waste of fuel in culinary processes, which arises from making liquids boil *unnecessarily*, or when nothing more would be necessary than to keep them *boiling-hot*, is enormous. I have not a doubt but that much more than half the fuel used in all the kitchens, public and private, in the whole world, is wasted precisely in this manner.

But the evil does not stop here. This unscientific and slovenly manner of cooking renders the process much more laborious and troublesome than otherwise it would be;—and, (what by many will be considered of more importance than either the waste of fuel, or the increase of labour to the cook,)—the food is rendered less savoury, and very probably less nourishing and less wholesome.

It is natural to suppose that many of the finer and more volatile parts of food (those which are best calculated to act on the organs of taste) must be carried off with the steam when the boiling is violent; but the fact does not rest on these reasonings;—it is *proved* to a demonstration, not only by the agreeable fragrance of the steam which rises from vessels in which meat is boiled, but also from  
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the strong flavour and superior quality of soups which are prepared by a long process over a very gentle fire.

In many countries where soups constitute the principal part of the food of the inhabitants, the process of cooking lasts from one meal-time to another, and is performed almost without either trouble or expence. As soon as the soup is served up, the ingredients for the next meal are put into the pot, (which is never suffered to cool, and does not require scouring,) and this pot,—which is of cast iron,—or of earthen ware,—being well closed with its thick wooden cover, is placed *by the side of the fire*, where its contents are kept simmering for many hours, but are seldom made to boil, and never but in the gentlest manner possible.

Were the pot placed in a closed fire-place, (which might easily be constructed, even with the rudest materials, with a few bricks or stone, or even with fods, like a camp-kitchen,) no arrangement for cooking could well be imagined more economical, or more convenient.

Soups prepared in this way are uncommonly favourable; and I am convinced that the true reason why nourishing soups, and broths, are not more in use among the common people in Great Britain and Ireland, is because they do not know how good they really are, nor how to prepare them; in short, because they are not acquainted with them.

But to return from this digression. It is most certain, not only that meat and vegetables of all kinds may be cooked in water which is kept *boiling-hot*, without actually boiling, but also that they may even be cooked with a degree of heat *below* the boiling point.

It is well known that the heat of boiling water is not the same in all situations;—that it depends on the pressure of the atmosphere,—and consequently is considerably greater at the level of the surface of the sea than inland countries, and on the tops of high mountains; but I never heard that any difficulty was found to attend the process of dressing food by boiling, even in the highest situations. Water boils at London, (and at all other places on the same level,) at the temperature of 212 degrees of Fahrenheit's thermometer; but it would be absolutely impossible to communicate that degree of heat to water in an open boiler in Bavaria. The boiling point at Munich under the mean pressure of the atmosphere at that place is about  $209\frac{1}{2}$  degrees of Fahrenheit's thermometer; yet nobody, I believe, ever perceived that boiled meat was *less thoroughly done* at Munich than at London. But if meat may, without the least difficulty, be cooked with the heat of  $209\frac{1}{2}$  degrees of Fahrenheit at Munich, why should it not be possible to cook it with the same degree of heat in London?—If this can be done, (which I think can hardly admit of a doubt,) then it is evident that the process of  
 cookery,

cookery, which is called *boiling*, may be performed in water which is not boiling-hot.

I well know, from my own experience, how difficult it is to persuade cooks of this truth, but it is so important, that no pains should be spared in endeavouring to remove their prejudices and enlighten their understandings. This may be done most effectually in the case before us by a method I have several times put in practice with complete success.—It is as follows:—Take two equal boilers, containing equal quantities of *boiling-hot water*, and put into them two equal pieces of meat taken from the same carcass,—two legs of mutton, for instance—and boil them during the same time. Under one of the boilers make a *small fire*, just barely sufficient to keep the water *boiling-hot*, or rather just *beginning to boil*:—under the other make *as vehement a fire as possible*, and keep the water boiling the whole time with the utmost violence.

The meat in the boiler in which the water has been kept *only just boiling-hot*, will be found to be quite as well done as that in the other \*, under which so much fuel has been wasted in making the water boil violently to no useful purpose.—It will even be more done; for as a great deal of water will be boiled away, (evaporated,) during the process, in the boiler under which a great fire is kept up, this boiler must often be filled up; and if the

\* It will even be found to be much better cooked,—that is to say, tenderer, more juicy, and much higher flavoured,



water with which it is from time to time replenished be cold, this will of course retard the process of cooking the meat.

To form a just idea of the enormous waste of fuel that arises from making water boil, and *evaporate* unnecessary in culinary processes, we have only to consider how much heat is expended in the formation of steam. Now it has been proved by the most decisive and unexceptionable experiments that have ever been made by experimental philosophers, that if it were possible that the heat which actually combines with water, in forming steam, (and which gives it wings to fly up into the atmosphere,)—could exist in the water, without changing it from a dense liquid to a rare elastic vapour, this water would be heated by it to the temperature of red-hot iron.

From the same *data* it is easy to shew, by computation, that if any given quantity of ice-cold water can be made to boil with the heat generated in the combustion of a certain quantity of any given kind of fuel, it will require more than *five times* that quantity of fuel to reduce that same quantity of water,—already boiling-hot,—to steam.

Hence it appears, that in the formation of steam there is a great and unavoidable *expence* of heat; but it does not seem probable that heat is *expended* or *combined*, in any of those processes by which food is prepared for the table,—except it be perhaps in baking;—and as heat is *immortal*,—that is to say,—as it never dies, or ceases to exist; and  
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as its dispersion may be prevented, or at least greatly *retarded*, by various simple contrivances, it is not surprising, when we consider the matter attentively, that most of those processes (in which nothing more seems to be necessary than that the food to be cooked should be exposed a certain time in a medium at a certain temperature) should be capable of being performed with a *very small expence of fuel*.

The quantity of heat, or rather the quantity of fuel, by which any given culinary process may be performed, may be determined with much certainty and precision from the results of experiments which have already been made.

Suppose, for instance, it were required to compute the quantity of dry pine-wood (what in England is called deal) used as fuel, and burned in a closed fire-place, constructed on the most approved principles, to boil 100 lbs. of beef. And first we will suppose this beef to be in such large pieces, that 3 hours of boiling, after it has been made boiling-hot, are necessary to make it sufficiently tender to be fit for the table: and we will suppose farther, that 3 lbs. of water are necessary to each pound of beef; and that both the water and the beef are at the temperature of  $55^{\circ}$  of Fahrenheit's thermometer (the mean temperature of the atmosphere in England) at the beginning of the experiment.

The first thing to be ascertained is how much fuel would be required to heat the water and the beef *boiling-hot*; and then to see how much more



would be required to *keep them boiling-hot* three hours.

And first for *heating the water*;—it has been shewn by one of my Experiments (N<sup>o</sup> 20, Essay VI.), that  $20\frac{1}{10}$  lbs. of water may be heated 180 degrees of Fahrenheit's thermometer with the heat generated in the combustion of 1 lb. of dry pine-wood.

But it is required to heat the water in question only 157 degrees; for its temperature being that of 55°, and the boiling point 212°, it is  $212^\circ - 55^\circ = 157^\circ$ : and if 1 lb. of the fuel be sufficient for heating  $20\frac{1}{10}$  lbs. of water 180 degrees, it must be sufficient for heating 23 lbs. of water 157 degrees—for  $157^\circ$  is to  $180^\circ$  as  $20\frac{1}{10}$  lbs. to 23 lbs.

But if 23 lbs. of water, at the temperature of 55°, require 1 lb. of dry pine-wood, as fuel, to make it boil, then 300 lbs. of water (the quantity required in the process in question) would require  $12\frac{6}{10}$  lbs. of the wood to heat it boiling-hot.

To this quantity of fuel must be added that which would be required to heat the meat (100 lbs. weight) boiling-hot. Now it has been found by actual experiment by the late ingenious Doctor Crawford, (see his Treatise on Animal Heat, second edition, page 490,)—that the flesh of an ox requires less heat to heat it than water, in the proportion of 74 to 100; consequently the quantity of beef in question (100 lbs.) might be made boiling-hot with precisely the same quantity of fuel as would be required to heat 74 lbs. of water at the same temperature to the boiling point.—And this  
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quantity in the case in question would amount to to  $3\frac{1}{4}$  lbs. as will be found on making the computation.

This quantity ( $3\frac{1}{4}$  lbs.) added to that before found, which would be required to heat the water alone, ( $=23$  lbs.) gives  $26\frac{1}{4}$  lbs. of dry pine-wood for the quantity required to heat 300 lbs. of water and 100 lbs. beef (both at the temperature of  $55^{\circ}$ ) boiling-hot.

To estimate the quantity of fuel which would be necessary to keep this water and beef boiling-hot 3 hours, we may have recourse to the results of my experiments. In the Experiment, N<sup>o</sup> 25, (see Essay VI.) 508 lbs. of boiling-hot water were kept actually boiling—not merely kept boiling-hot)—3 hours with the heat generated in the combustion of  $4\frac{1}{2}$  lbs. of dry pine-wood,—this gives  $338\frac{2}{3}$  lbs. of boiling-hot water kept boiling 1 hour with 1 lb. of the fuel; and computing from these data.—And supposing farther that a pound of beef requires as much heat to keep it boiling-hot any given time as a pound of water, it appears that  $3\frac{1}{2}$  lbs. of pine wood, used as fuel, would be sufficient to keep the 300 lbs. of water, with the 100 lbs. of beef in it, boiling 3 hours. This quantity of fuel ( $=3\frac{1}{2}$  lbs.), added to that required to heat the water and the meat boiling-hot ( $=26\frac{1}{4}$  lbs.), gives  $29\frac{1}{4}$  lbs. of pine wood, for the quantity of fuel required to cook 100 lbs. of boiled beef.

This quantity of fuel, which is just about equal in effect to 16 lbs.—or  $\frac{3}{4}$  of a peck of pit-coal, will  
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doubtless be thought a small allowance for boiling 100 lbs. of beef; but it is in fact much more than would be necessary *merely for that purpose*, could all the heat generated in the combustion of the fuel be applied *immediately* to the cooking of the meat, and *to that purpose alone*. Much the greatest part of that which is generated is expended in heating the water in which the meat is boiled, and as it remains in the water after the process is ended it must be considered as lost.

This loss may, however, be prevented in a great measure; and when that is done, the expence of fuel in boiling meat will be reduced almost to nothing. We have just seen that 100 lbs. of meat, at the mean temperature of the atmosphere in England, ( $55^{\circ}$ ), may be made boiling-hot with the heat generated in the combustion of  $3\frac{1}{4}$  lbs. of pine-wood; and there is no doubt but with the use of proper means for confining the heat, this meat might be kept boiling-hot 3 hours, and consequently be thoroughly done, with the addition of  $\frac{3}{4}$  of a pound of the fuel, making in all 4 lbs. of pine-wood, equal in effect to about  $2\frac{1}{4}$  lbs. of pit-coal; which, according to this estimate, is all the fuel that would be *absolutely necessary* for cooking 100 lbs. of beef.

This quantity of fuel would cost in London less than *one farthing and a half*, when the chaldron of coals weighing 28 cwt. is sold at 40 shillings. This, however, is the *extreme* or *utmost limit* of the economy of fuel, beyond which it is absolutely impossible

fible to go. It is even impossible in practice, to arrive at this limit, for the containing vessel must be heated, and kept hot, as well as the meat ;— but very considerable advances may be made towards it, as I shall shew hereafter.

If we suppose the meat to be boiled in the usual manner, and that 300 lbs. of cold water are heated expressly for that purpose, in that case the fuel required, amounting to 16 lbs. of coal, would cost in London—(the chaldron reckoned as above)—just 2 pence  $1\frac{3}{4}$  farthings. But all this expence ought not to be placed to the account of the cooking of the meat ; by adding a few pounds of barley-meal, some greens, roots, and seasoning, to the water, it may be changed into a good and wholesome soup, at the same time that the meat is boiled ; and the expence for fuel (2 pence  $1\frac{3}{4}$  farthings) may be divided between the meat boiled, (100 lbs.) and 300 lbs. or  $37\frac{1}{2}$  gallons of soup.

I am aware of the danger to which I expose myself by entertaining the public with accounts of facts, and of deductions from them which are certainly much too new and extraordinary to be credited, but on the strongest proofs, while many of the arguments and computations I offer in their support, however conclusive they may, and certainly *must*, appear to natural philosophers and mathematicians,—are such as the generality of readers will be tempted to pass over without examination ; but deeply impressed with the importance of  
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the object I have in view, I am determined to pursue it at all hazards.

My principal design in publishing these computations is to *awaken the curiosity of my readers*, and fix their attention on a subject, which however low and vulgar it has hitherto generally been thought to be, is, in fact, highly interesting, and deserving of the most serious consideration. I wish they may serve to inspire cooks with a just idea of the importance of their art,—and of the intimate connection there is between the various processes in which they are daily concerned, and many of the most beautiful discoveries that have been made by experimental philosophers in the present age.

The advantage that would result from an application of the late brilliant discoveries in Philosophical Chemistry, and other branches of Natural Philosophy and Mechanics, to the improvement of the Art of Cookery, are so evident, and so very important, that I cannot help flattering myself that we shall soon see some enlightened and liberal-minded person of the profession take up the matter in earnest, and give it a thoroughly *scientific* investigation.

In what art or science could improvements be made that would more powerfully contribute to increase the comforts and enjoyments of mankind?

And it must not be imagined that the saving of fuel is the only or even the most important advantage



vantage that would result from these inquiries :— others, of still greater magnitude, respecting the *manner* of preparing food for the table, would probably be derived from them.

The heat of boiling water, continued for a shorter or a longer time, having been found by experience to be sufficient for cooking all those kinds of animal and vegetable substances that are commonly used as food; and *that degree* of heat being easily procured, and easily kept up, in all places and in all seasons; and as all the utensils used in cookery are contrived for that kind of heat, few experiments have been made to determine the effects of using *other degrees of heat*, and *other mediums* for conveying it to the substance to be acted upon in culinary processes. The effects of different degrees of heat in the same body are however sometimes very striking, and the taste of the same kind of food is often so much altered by a trifling difference in the manner of cooking it, that it would no longer be taken for the same thing. What a surprising difference, for instance, does the manner of performing that most simple of all culinary processes, *boiling in water*, make on potatoes! — Those who have never tasted potatoes *boiled in Ireland*, or cooked according to the Irish method, can have no idea what delicious food these roots afford when they are properly prepared. But it is not merely the *taste* of food that depends on the manner of cooking it; its nutri-

tioufness also, and its wholesomenefs, qualities still more effential if poffible than tafte, are no doubt very nearly connected with it.

Many kinds of food are known to be moft delicate and favoury when cooked in a degree of heat confiderably below that of boiling water; and it is more than probable that there are others which would be improved by being expofed in a heat greater than that of boiling water.

In the fea-port towns of the New England States in North America it has been a cuftom, time immemorial, among people of fafhion, to dine one day in the week (Saturday) on *ſalt-fiſh*, and a long habit of preparing the ſame diſh has, as might have been expected, led to very confiderable improvements in the art of cooking it. I have often heard foreigners who have aſſiſted at theſe dinners, declare that they never taſted ſalt-fiſh dreſſed in ſuch perfection; and I well remember that the ſecret of cooking it is to keep it a great many hours in water that is *juſt ſcalding hot*, but which is never made aſtually to boil.

I had long ſuſpected that it could hardly be poſſible that *precifely* the temperature of 212 degrees of Fahrenheit's thermometer (that of boiling water) ſhould be that which is beſt adapted for cooking *all ſorts of food*; but it was the unexpected reſult of an experiment that I made with another view, which made me particularly attentive to this ſubject. Deſirous of finding out whether it would  
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be possible to roast meat in a machine I had contrived for drying potatoes, and fitted up in the kitchen of the House of Industry at Munich, I put a shoulder of mutton into it, and after attending to the experiment three hours, and finding it shewed no signs of being done, I concluded that the heat was not sufficiently intense; and despairing of success, I went home, rather out of humour at my ill success, and abandoned my shoulder of mutton to the cook maids.

It being late in the evening, and the cook maids thinking perhaps that the meat would be as safe in the drying machine as anywhere else, left it there all night. When they came in the morning to take it away, intending to cook it for their dinner, they were much surprised to find it *already cooked*, and not merely eatable, but perfectly done, and most singularly well-tasted. This appeared to them the more miraculous, as the fire under the machine was gone quite out before they left the kitchen in the evening to go to bed, and as they had locked up the kitchen when they left it, and taken away the key.

This wonderful shoulder of mutton was immediately brought to me in triumph, and though I was at no great loss to account for what had happened, yet it certainly was quite unexpected; and when I tasted the meat I was very much surprised indeed to find it very different, both in taste and flavour, from any I had ever tasted. It was perfectly

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tender; but though it was so much done, it did not appear to be in the least sodden or insipid; on the contrary, it was uncommonly savoury and high flavoured. It was neither boiled, nor roasted, nor baked. Its taste seemed to indicate the manner in which it had been prepared: that the gentle heat to which it had for so long a time been exposed, had by degrees loosened the cohesion of its fibres, and concocted its juices, without driving off their fine and more volatile parts, and without washing away or burning and rendering rancid and empyrumatic its oils.

Those who are most likely to give their attention to this little history will perceive what a wide field it opens for speculation and curious experiment. The circumstances I have related, however trifling and uninteresting they may appear to many, struck me very forcibly, and recalled to my mind several things of a similar nature which had almost escaped my memory. They recalled to my recollection the manner just described in which salt-fish is cooked in America; and also the manner in which *samp* is prepared in the same country. (See my Essay on Food.) This substance, which is exceedingly palatable and nourishing food when properly cooked, *is not eatable* when simply boiled. How many cheap articles may there be of which the most delicate and wholesome food might be prepared, were the art and the *science* of cooking them better understood?

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—But I beg my reader's pardon for detaining him so long with speculations which he may perhaps consider as foreign to the subject I promised to treat in this Essay.—To proceed therefore to those investigations which are more immediately connected with the construction of Kitchen Fireplaces.—



## CHAP. I.

*Of the imperfections of the Kitchen Fire-places now in common use.—Objects particularly to be had in view in attempts to improve them.—Of the distribution of the various parts of the machinery of a Kitchen.—Of the method to be observed in forming the plan of a Kitchen that is to be fitted up, and in laying out the work.*

As the principal object of this publication is to convey such plain and simple directions for constructing Kitchen Fire-places and Kitchen Utensils as may easily be understood, even by those who are not versed in philosophical inquiries, and who have not had leisure to examine scientifically the principles on which the proposed improvements are founded, I shall endeavour, in treating the subject, to make use of the plainest language, and to avoid as much as possible all obtruse and difficult investigation.

It will be proper to begin by taking a cursory view of Kitchen Fire-places, as they are now commonly constructed, and to point out their defects; and shew what the objects are which ought principally to be had in view in attempts to improve them.

*Of the imperfections of the Kitchen Fire-places now in common use.*

THE great fault in the construction and arrangement of the Kitchens of private families now in common use in most countries, and particularly in Great Britain and Ireland, (a fault from which all their other imperfections arise,) is, that they are not *closed*. The fuel is burnt in a long open grate called a *kitchen-range*; over which the pots and kettles are freely suspended, or placed on stands; or fires are made with charcoal in square holes, called *stoves*, in a solid mass of brick-work, and connected with no flue to carry off the smoke, over which holes stewpans or saucepans are placed on tripods, or on bars of iron, exposed on every side to the cold air of the atmosphere.

The loss of heat and waste of fuel in these Kitchens is altogether incredible; but there are other evils attending them, which are perhaps still more important. All the various processes in which fire is used in preparing food for the table are extremely unpleasant and troublesome in these Kitchens, not only on account of the excessive heat to which those are exposed who are employed in them, but also and more especially on account of the *noxious exhalations* from the burning charcoal; and the *currents of cold air* in the Kitchen, which are occasioned by the strong draft up the chimney.



It is sufficient to have once been in a kitchen when dinner was preparing for a large company,—or even merely to have met the cook coming sweltering out of it, to be convinced that the business of cooking, as it is now performed, is both disagreeable and unwholesome: and it appears to me, that it would be no small addition to the enjoyments of those who are fond of the pleasures of the table to know that they were procured with less trouble and with less injury to the health of those who are employed in preparing them.

Another inconvenience attending open chimney Fire-places, as they are now constructed, is the great difficulty of preventing their smoking. In order that there may be room for all the pots and kettles which are placed over the fire, the grate, or *kitchen-range*, as it is called, must be very long,—and in order that the cook may be able to approach these pots, &c. the mantle of the chimney is made very high; consequently the throat of the chimney is not only enormously large, but it is situated very high above the burning fuel; both of which circumstances tend very much to make a chimney smoke, as I have shown in my Essay on Open Chimney Fire-places; and there does not appear to be any effectual remedy for the evil, without altering entirely the construction of such Fire-places.



*Of the objects particularly to be had in view in attempts to improve Kitchen Fire-places.*

THE objects which ought principally to be attended to in the arrangement of a kitchen, are the following :

1<sup>st</sup>, Each boiler, kettle, and stewpan, should have its separate closed Fire-place.

2<sup>dly</sup>, Each Fire-place should have its grate, on which the fuel must be placed, and its separate ash-pit, which must be closed by a door well-fitted to its frame, and furnished with a register for regulating the quantity of air admitted into the Fire-place through the grate. It should also have its separate canal for carrying off the smoke into the chimney ; which canal should be furnished with a damper. By means of this damper and of the ash-pit door register, the rapidity of the combustion of the fuel in the Fire-place, and consequently the rapidity of the generation of the heat, may be regulated at pleasure. The economy of fuel will depend principally on the proper management of these two registers.

3<sup>dly</sup>, In the Fire-places for all boilers and stewpans which are more than eight or ten inches in diameter, or which are too large to be easily removed with their contents *with the strength of one hand*, an horizontal opening just above the level of the  
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the grate must be made for introducing the fuel into the Fire-place ; which opening must be nicely closed by a fit stopper, or by a double door. In the Fire-places which are constructed for smaller stewpans this opening may be omitted, and the fuel may be introduced through the same opening into which the stewpan is fitted, by removing the stewpan occasionally for a moment for that purpose.

4thly, All portable boilers and stewpans, and especially such as must often be removed from their Fire-places, should be *circular*, and they should be suspended in their Fire-places by their circular rims ; but the best form for all fixed boilers, and especially such as are very large, is that of an oblong square, and all boilers, great and small, should rather be *broad and shallow* than narrow and deep.

A circular form is best for portable boilers, on account of the facility of fitting them to their Fire-places ; and an oblong square form is best for large fixed boilers, on account of the facility of constructing and repairing the strait horizontal flues under them and round them, in which the flame and smoke by which they are heated is made to circulate.

When large boilers are shallow, and when their bottoms are supported on the tops of narrow flues, the pressure or weight of their contents being supported by the walls of the flues, the metal of which the boiler is constructed may be *very thin*, which will not only diminish very much the first cost of the boiler,

boiler, but will also greatly contribute to its *durability*; for the thinner the bottom of a boiler is, the less it is *fatigued* and *injured* by the action of the fire, and the longer of course it will last; which is a curious fact, that has hitherto been too little known, or not enough attended to in the construction of large boilers.

5thly, All boilers, great and small, should be furnished with covers, which covers should be constructed in such a manner, and of such materials as to render them well adapted for confining heat. Those who have never examined the matter with attention would be astonished on making the experiment to find how much heat is carried off by the cold air of the atmosphere from the surface of hot liquids, when they are exposed naked to it, in boilers without covers: but in culinary processes it is not merely the loss of heat which is to be considered;—a great proportion of the finer and more rich and savoury particles of the food are also carried off at the same time, and lost, which renders it an object of serious importance to apply an effectual remedy to this evil.

As heat makes its way through wood with great difficulty, and very slowly, there would perhaps be no substance better adapted for constructing covers for boilers than it, were it not for the perpetual changes in its form and dimensions which are occasioned by alternate changes of dryness and moisture, but these alterations are so considerable, and their effects so difficult to be counteracted, especially

cially when the form of the cover is circular, that for portable boilers, and for stewpans and saucepans, I should prefer covers made of thin sheets of tinned iron, or of *tin* as it is commonly called. These covers (which must always be made *double*) have already been particularly described in my *Sixth Essay*.

Though boilers and stewpans should never be used naked over an open fire, or otherwise than in closed Fire-places, yet it is not necessary in fitting up a kitchen to build as many separate Fire-places as it may be proper to have boilers, stewpans, and saucepans; for the same Fire-place may be made to serve occasionally for several boilers or stewpans. Those however that are used in the same closed Fire-place must be all of the same diameter; and in order that their capacities may be different, they may be made of different depths.

As in the hurry of business in the kitchen, one stewpan or boiler might easily be taken for another, were their diameters to vary by only a small difference, and were they not distinguished by marks or numbers; to prevent these mistakes their diameters, expressed in inches, should be marked on some conspicuous part; on their handles for instance, or on their brims, and also on their covers; and their Fire-places should be marked with the same number.

To guard still more effectually against all mistakes respecting the sizes of these utensils, and the Fire-places to which they belong, the difference

ference of the diameters of two boilers or stew-pans should never be less than *one whole inch*. In several private kitchens that have been constructed on my principles, their diameters have been made to vary by *two inches*, that is to say, they have been made of 6, 8, 10, 12, and 14 inches in diameter; and in order that those of the same diameter might be of different capacities, they were made of three different depths, namely,  $\frac{1}{3}$ ,  $\frac{1}{2}$ , and  $\frac{2}{3}$  their diameter in depth. Not only the numbers which shew their diameters, but the fractions also which express their depths are marked on their handles, or on their brims.

The size of a private kitchen, or the number and size of its separate closed Fire-places, and of its boilers and stewpans, must be regulated by the size of the family, or rather by the style of living; for where sumptuous entertainments are occasionally provided for large companies, the kitchen must be spacious, and its arrangement complete, however small the family may be, or however moderate the expences of their table may be in their ordinary course of living in private.

Yet when kitchens are fitted up on the principles I am desirous of recommending, neither the size of the kitchen, nor the number or dimensions of its utensils, will occasion any addition to the table expences of the family in their ordinary course of living when they have no company, which is an important advantage that these kitchens have over those on the common construction.

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In large kitchens with open Fire-places, the kitchen range being wide and very roomy, an enormous quantity of fuel is swallowed up by it, even when only a very small quantity of food is provided; but this unnecessary waste is completely prevented by cooking in boilers and stewpans properly fitted into separate closed Fire-places.

More fuel is frequently consumed in a kitchen range to boil a tea-kettle, than, with proper management, would be sufficient to cook a dinner for fifty men.

*Of the distribution of the various parts of the machinery of a kitchen.*

THOUGH the internal construction of the Fire-places, and the means employed for confining and directing the heat generated in the combustion of the fuel, (subjects which have been thoroughly investigated in my Sixth Essay,)—are matters of the first concern in the fitting up of a kitchen, yet these are not all that require attention; the distribution of the various parts of the machinery is a matter of considerable importance, for a good arrangement of the different instruments and utensils;—of the boilers—ovens—roasters, &c.—will tend very much to facilitate the business of cooking, and consequently *to put the cook in good humour*; which is certainly a matter of serious importance.

*Cooks*

*Cooks* in general are averse to all new inventions, and this is not surprising, and ought by no means to be imputed to them as a fault. Accustomed to *work with their own tools*, they naturally feel awkward and embarrassed when others are put into their hands; and to this we may add, that there is always a degree of humiliation felt by those who, after having been accustomed to consider themselves, and to be considered by others, as masters of their profession, are required to learn any thing new, or to do any thing in any other manner than that in which they have always been accustomed to do it, and in the performance of which they have always acquired praise. It will not however be difficult to convince those of the profession who are possessed of a good understanding, and are above low and vulgar prejudices, that the alterations proposed will most certainly meet with their approbation, *when they become better acquainted with them.*

The distribution of the parts of a kitchen must always depend so much on local circumstances, that general rules can hardly be given respecting it; the principles, however, on which this distribution ought in all cases to be made, *viz.* convenience to the cook, — cleanliness, — and symmetry, — are simple, and easy to be understood; and in the application of them, the architect will have a good opportunity of displaying his ingenuity, and showing his taste.

Should



Should he condescend to consult the cook in making these arrangements he will do wisely, on more accounts than one.

Though the smoke from the Fire-places of the boilers may be conveyed almost to any distance in horizontal canals, yet it will in most cases be advisable to place the boilers near the chimney;—and it will in general, though not always, be best to place them all in one range, or rather in one mass of brick-work.

*Of the method of forming a plan of a Kitchen that is to be fitted up ; and of laying out the work.*

BEFORE the plan of a kitchen which it is intended to fit up is made, an exact plan must be procured of the room in which it is to be constructed, in which plan all the doors and windows must be distinctly marked, and also the Fire-place, if there be one in the room, and the chimney. The number and the dimensions must likewise be known of all the boilers and saucepans which are to be fitted up in the brick-work.

The readiest way of proceeding in making a plan or drawing of the machinery of a kitchen is to form it on the plan of the room; and in doing this the work will be much facilitated by the following very simple contrivance.

Cut out of thick pasteboard, detached pieces to represent the boilers, — saucepans, — roasters, — ovens, &c. which are to be fitted up in the brick-work, and placing these in different ways on the plan of the room, see in what manner they can best be disposed, or arranged. As these models (which must be drawn to the same scale as that used in drawing the plan of the room) may be moved about at pleasure, and placed in an infinite variety of different positions in regard to each other, and to the different parts of the room; the effect of any proposed arrangement may be tried in a few moments, in a very satisfactory manner, without expence, and almost without any trouble.

To facilitate still more these preliminary trials with these models of the boilers, &c. several slips of pasteboard, equal in width to the distance at which one boiler ought to be placed from the other in the brick-work, measured on the scale of the plan, should be provided and used in placing the models of the boilers at proper distances from each other. This distance in fitting up or setting kitchen boilers and saucepans, I have commonly taken at the width of a brick, or  $4\frac{1}{2}$  inches, and I have allowed the same space—( $4\frac{1}{2}$  inches)—for the distance of the side of the boiler from the outside or front of the mass of the brick-work in which it is set. When this point is settled, (that respecting the distance which should be left between the boilers,) the

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arranging

arranging of the pasteboard models of the boilers on the plan will be perfectly easy.

As soon as the distribution of the various boilers, &c. is finally settled, a ground plan of the whole of the machinery should be traced on the plan of the room; and a sufficient number of sections and elevations should be drawn to show the situations, forms, and dimensions of the Fire-places, and of all the other parts of the apparatus.

When this is done,—and when the boilers and the materials for building are provided, and every thing else that can be wanted in fitting up the kitchen is in readiness, the architect or *amateur* may proceed to the laying out of the work.

As this will not be found to be difficult, and as it is really a most amusing occupation, I cannot help recommending it very earnestly to gentlemen, and even to ladies,—to superintend and direct these works.

I don't know what opinion others may entertain of these amusements, but with regard to myself I own that I know of nothing more interesting than the planning and executing of machinery, by which the powers of Nature are made subservient to my views;—by which the very elements are bound as it were in chains, and made to obey my despotic commands.—And not my commands alone, but those of all the human race to whose necessities and comforts they are made the faithful and obedient ministers!

The first thing to be done in laying out the work when a kitchen is to be fitted up, is to draw with red or white chalk, or with a coal, a ground plan of the brick-work, of the full size, on the floor or pavement of the room. When the kitchen is neither paved nor floored, this drawing must of course be made on the ground. In this drawing, the ash-pits, and the passages leading to them must be marked, and when the ash-pit is to be sunk into the ground, that is the first thing that must be executed.

As soon as this ground plan is sketched out, the ash-pit doors should all be placed, and the foundations of the brick-work laid.

To assist the bricklayer, and prevent his making mistakes, several sections of the brick-work of the full size, and particularly sections of all the boilers, represented as fixed in their Fire-places, should be drawn on wide boards, or on very large sheets of paper,—or they may be drawn with charcoal or red chalk on the sides of the room. These sections of the full size, where the bricklayer can readily take measure of the various parts of the work to be performed, will be found very useful.

Before I proceed to give a more particular and minute description of the various Kitchen Utensils and other machinery which will be recommended, I shall lay before my reader an account, illustrated by drawings, of several complete kitchens that have already been constructed under my direction. I have been induced to adopt this method in treating  
my

my subject, from an opinion that the directions which still remain to be given respecting the construction of Kitchen Fire-places, and of Kitchen Utensils, will more easily be understood when a general idea shall have been formed of some of those kitchens which have already been constructed on the principles recommended.

## C H A P. II.

*Detailed accounts, illustrated by correct plans, of various Kitchens, public and private, that have already been constructed on the Author's principles, and under his immediate direction.*

ONE of the most complete kitchens I have ever yet caused to be constructed is, in my opinion, that belonging to Baron de Lerchenfeld at Munich, and although its general form and the distribution of the machinery are very different from any thing that has been seen in this country;—so different that I should, perhaps, doubt whether it would be prudent at the first outset to recommend their adoption and exact imitation; yet, as this kitchen has been found to answer remarkably well; even to the entire satisfaction of the cook, who began however by entering his formal protest against it, I have thought it right to lay the following description of it before my readers. Those who are alarmed at the novelty of its appearance will be so good as to recollect that much may be done, as will hereafter be shown, by way of accommodating the plan to the idea of those to whom it is too new not to appear extraordinary and uncouth.

*Description*



*Description of a Kitchen in the House of* BARON DE  
LERCHENFELD *at* MUNICH.

## P L A T E I.

Fig. 1. This Plate shows a perspective view of the Kitchen Fire-place seen nearly in front. The mass of brick-work in which the boilers and sauce-pans are set, projects out into the room, and the smoke is carried off by flues that are concealed in this mass of brick-work, and in the thick walls of an open chimney Fire-place which, standing on it, on the farther side of it, where it joins to the side of the room, is built up perpendicularly to the ceiling of the room. At the height of about twelve or fifteen inches above the level of the mantle of this open chimney Fire-place, the separate canals for the smoke concealed in its walls end in the larger canal of this Fire-place, which last-mentioned larger canal sloping backwards, ends in a neighbouring chimney which carries off the smoke through the roof of the house into the atmosphere.

An horizontal section of this open chimney Fire-place, at the level of the upper surface of the mass of brick-work on which it stands, may be seen Plate III. fig. 5. In this section the vertical canals are distinctly marked, which carry off the smoke from the boilers into the chimney, as also the stoppers which are occasionally taken away to

remove the foot, when these canals are cleaned. These stoppers, which are made of earthen ware burnt like a brick or tile, are eight inches long, six inches wide, and three inches thick, and on their outsides they have two deep grooves that form a kind of handle for taking hold of them. When they are fixed in their places, their joinings with the door-way into which they are fitted are made tight by filling up the crevices with moist clay. The canals are cleaned by means of a strong cylindrical brush, made of hogs' bristles fixed to a long flexible handle of twisted iron wire.

The open chimney Fire-place was constructed in order that an open fire might be made on its hearth, (which, as appears by the plan, is on a level with, or is a continuation of the top or upper surface of the mass of brick-work in which the boilers are set,) should any such fire be wanted; but the fact is, that although this kitchen has been in daily use more than five years, it has not yet been found necessary to light a fire in this place. When any thing is to be fried or broiled, the cook finds it very convenient to perform these processes of cookery over the two large stoves that are placed in the front of this open Fire-place; as the disagreeable vapour that rises from the frying-pan or from the gridiron, goes off immediately by the open chimney: and these stoves serve likewise occasionally for warming heaters for ironing, and also for burning wood to obtain live coals for warming beds, or for keeping up a small fire for  
boiling

boiling a tea-kettle, or for warming any thing that is wanted in the family. When this fire is not wanted, the register in the ash-pit door is nearly closed, and the top of the stove is covered with a fit cover of earthen-ware, by which means the fire is kept alive for a great length of time, almost without any consumption of fuel ; and may at any time be revived and made to burn briskly in less than half a minute, merely by admitting a larger current of fresh air.

The convenience in a family of being able to have a brisk fire in the kitchen in a moment, when wanted, and to check the combustion in an instant, without extinguishing the fire, and without even cooling the Fire-place, when the fire is no longer wanted, can hardly be conceived by those who have not been used to any other methods of making and keeping up kitchen fires than those commonly used in the kitchens in Great Britain.

It will certainly be confessed that neither science nor art has done much either for saving labour or for saving expence,—either for convenience, comfort, cleanliness, or economy in the invention and management of a *kitchen range*.

Before I proceed to explain more minutely the different parts of this kitchen, it may be useful to give a general idea of the whole of it, taken together.

## P L A T E II.

Fig. 2. This figure shows a front view, or, more strictly speaking, an elevation of this kitchen. In this plan the ash-pit doors with their registers are distinctly seen; and also the ends of the earthen stoppers which close the openings into the Fire-places\* of four of the principal boilers. The covers of the principal boilers†, as also of several of the stewpans, are seen above the level of the upper surface of the mass of brick-work.

The height of this mass of brick-work *a b*, measured from the floor or pavement of the kitchen, is just three feet.

Fig. 3. This figure shews an horizontal section of the mass of brick-work in which the boilers, &c. are set, taken at the level of the horizontal flues, that carry off the smoke from the boilers, stewpans, and saucepans, into the vertical canals which convey it into the chimney.

The smoke from three of the principal boilers, situated on the left-hand, is carried by separate canals to a circular cavity, over which a large shallow boiler is placed, in which water is heated

\* For a particular account of these stoppers, see p. 30—188, and Plate I. figures 6, 7, and 8, Essay VI.

† For an account of these covers, see p. 18—187. and Plate I. figures 1 and 2, Essay VI.

(by

(by this smoke) for the use of the kitchen, and more especially for washing the plates and dishes. This boiler is distinctly seen with its wooden cover, (consisting of three pieces of deal united by two pairs of hinges) in the figure 5, Plate III.

The five Fire-places on the left-hand side of the mass of brick-work are represented without their circular grates, and the eight Fire-places that are situated on the right-hand, are shown with their circular grates in their places \*.

The Fire-places of the four largest boilers, which are situated in front of the brick-work, have doors or openings, closed with stoppers, for introducing fuel into these Fire-places, and three of these openings are represented in the plan as being closed by their stoppers; while the fourth (that situated on the right hand) is shown open, or without its stopper.

As all the rest of the Fire-places (or stoves as they would be called in this country) are without any lateral opening for introducing the fuel, when any fuel is to be introduced into one of these Fire-places the stewpan or saucepan must be removed for a moment for that purpose.

It will be observed that several of the horizontal canals that carry off the smoke from the boilers are divided into two branches, which unite at a little

\* For a particular description of these circular grates, see p. 41—187. and Plate I figure 3 and 4. In Great Britain these grates may be made very cheap of cast iron.



distance from their Fire-places ;—this contrivance is very useful, especially for closed Fire-places that are without flues under the boilers, as it occasions the flame to divide under the bottom of the boiler, and to play over every part of it in a thin sheet.

The reason why flues were not made under these boilers was to render it possible to use occasionally several boilers of different depths in the same Fire-place ; a convenience of no small importance in the kitchen of a private gentleman, who occasionally gives dinners to large companies.

It will be perceived that in the Fire-places of all the stewpans and saucepans there are circular flues which oblige the flame to make one complete turn round the sides of the vessel, before it goes off into the horizontal canal ; but I am far from being sure that the saving of fuel, arising from this peculiar arrangement, is sufficient to counterbalance the loss of that great convenience that results from being able to use indifferently stewpans and saucepans of different depths in the same stove, which cannot be obtained while these circular flues remain.

They will indeed be rendered unnecessary, provided that the flame be made to divide under the bottom of the vessel, (which may be done by causing it to enter the horizontal canal by two opposite openings,) and provided that this canal be furnished with a good damper,—WHICH OUGHT NEVER TO BE OMITTED. Although, to avoid the confusion that is apt to result from the delineation  
of



of a multitude of different objects in the same drawing, the dampers to the canals are all omitted in these plans, they must on no account be left out in practice; for they are of such importance, that there is no possibility of managing fires properly without them: and as it is of very little importance whether they be placed near the fire or far from it, or what is their form, provided they be so constructed as to diminish at pleasure, and occasionally to close entirely the canal by which the smoke makes its escape, it is not necessary for me to give any particular directions how they are to be made: indeed their construction is so very simple, and so generally known, that it would be quite superfluous for me to enlarge on that subject.

The dotted lines leading from the front of the brick-work to the Fire-places show the position and dimensions of the ash-pits.

The whole length of the mass of brick-work from A to B is eleven feet, and its width from A to C is seven feet four inches. The space it occupies on the ground may be conceived to consist of six equal squares of forty-four inches each, placed in two rows of three squares each; these two rows being joined to each other by their sides, and forming together a parallelogram. And in laying out the work when a kitchen is to be fitted up on the plan here described, it will always be best to begin by actually drawing these six squares on  
the

the floor of the kitchen. Nearly the whole of the middle square of the back row is occupied by the open chimney Fire-place, and by its thick hollow walls; and the greater part of the middle square of the front row is left as a passage for the cook to come to the open chimney Fire-place, or rather to the stoves that are situated near it.

### PLATE III.

Fig. 4. This figure, which represents a vertical section of the mass of brick-work through the centres of the Fire-places of the four principal boilers, is chiefly designed to show the construction of those Fire-places, and also that of the boilers. Sections of the circular grates on which the fires are made to burn under the boilers are here represented, and also sections of the ash-pits, and of the contractions of the Fire-places immediately below the grates \*; and in one of the Fire-places, which is shown without its boiler, the openings of the branched canal by which the smoke goes off horizontally towards the chimney, are also marked.

Fig. 5. This figure shows a bird's-eye view of the upper surface of the brick-work, with all the boilers and saucapans in their places, except one;

\* For an account of the utility of these contractions, see Essay VI. page 43.

three of the principal boilers and one saucepan with their covers on ; and the rest of them without their covers. It likewise represents an horizontal section of the open chimney Fire-place, four inches above the level of the top of the mass of brick-work in which the boilers and saucepans are set.

It is to be observed, that all the boilers, stewpans, and saucepans, are fitted into circular rings of iron, which are firmly fixed to the brick-work ; and that they are suspended in their Fire-places by their circular rims. All the stewpans and saucepans, that are not too large to be lifted with their contents in and out of their Fire-places with the strength of one hand, have iron handles attached to their circular rims ; but the four principal boilers, which are too large to be managed with one hand, have each two rings fitted to their rims. These handles and rings are so constructed, that they do not prevent the saucepans and boilers from fitting the circular openings of their Fire-places ; neither do they prevent their being fitted by their own circular covers.

It will doubtless be observed, that the four principal boilers shown in fig. 4. belonging to the kitchen I am now describing, differ but very little in form from the boilers in common use, and consequently that they are considerably deeper in proportion to their width than they ought to be, in order that the heat generated in the combustion of the fuel might act upon them to the greatest advantage ; but it is to be remembered that to each of these Fire-places there are other shallower boilers  
that

that are used occasionally, which do not appear in these plans. There is however one advantage attending deep boilers, to which it may in some cases be useful to pay attention, and that is, that they economize *space* in a kitchen; and when their Fire-places are properly constructed, and above all when they are furnished with good registers and dampers, the additional quantity of fuel they will require will be too trifling to be considered. The walls of their Fire-places will absorb more heat in the beginning, but who knows but that the greater part of this heat may not afterwards be emitted in rays, and at last find its way into the boiler? I could mention several facts that have lately fallen under my observation, which seem to render this supposition extremely probable.—This however is not the proper place to give an account of them.

As I have said that no fire has yet been made in the open chimney Fire place of the kitchen I am describing, it may perhaps be asked how this kitchen is warmed in cold weather. To this I answer, that it has been found that the mass of brick-work is made sufficiently hot by the fires that are kept up in it when cooking is going on every day, to keep the room comfortably warm in the coldest weather.

This answer will probably give rise to another question, which is;—how we contrive to prevent the room from being much too warm in summer? By opening one of the windows a very little, and by opening at the same time the register of a  
wooden

wooden tube or steam-chimney, which, rising from the cieling of the room, ends in the open air; and which is always opened to clear the room of vapour when it is found necessary, and especially when the victuals are taken out of the boilers, or when any other operation is going on that occasions the diffusion of a considerable quantity of steam. The oblong opening of this steam-chimney may be seen Plate I. Fig. 1. in the ceiling, at the right hand corner of the room.

Near this corner of the room may likewise be seen a front view of the hither end of one large roaster, and part of the front view of a smaller one situated by the side of it; both with their separate Fire-place doors.

The Fire-place door of the larger roaster, as also both its blow-pipes, are represented as being open; but the ash-pit door of this roaster is hid by the mass of brick-work in which the boilers are set. A particular account of these roasters will be given hereafter.

The dimensions of the boilers in this kitchen are as follows:

	Wide at the brim.	Deep.
	Inches.	Inches.
One large boiler heated by smoke -	20	8
Two large boilers - - - - -	16	16
Two ditto used occasionally in the Fire-places of the two boilers last mentioned - - - - -	16	8
Two smaller boilers - - - - -	12	12
Two ditto fitted to the same Fire-places	12	6
VOL. III.	E	The



The diameters of the stewpans and saucepans are 12, 10, and 8 inches ; and their depth is made equal to half their diameters.

The fuel burnt in this kitchen is wood ; and the billets used are cut into lengths of about six inches.

Common bricks were used in the construction of the Fire-places, but care was taken to lay them in mortar composed of clay and brickdust, without any sand, with only a very small proportion of lime.

In this kitchen, as also in that which I am now about to describe, the mass of brick-work in which the boilers are set projects into the room from the middle of one side of it.

*Description of the KITCHEN of the Hospital of  
LA PIETA at VERONA.*

PLATE IV. Fig. 6. This figure represents the ground plan of the mass of brick-work in which the boilers are fixed, and the canals by which the smoke is carried off from the Fire-places into the Chimney. The ground covered by this mass of brick-work, and by the area (y) between the boilers, may be conceived to be divided into six equal squares, of 43 inches, placed in two rows of three squares each. In the centres of four of these squares, namely, of those which are situated at the ends of the rows, are placed four large circular boilers.—The middle square of the front row is chiefly occupied by the  
area



area which is left between the two front boilers; and one half of the middle square of the back row is occupied by an open Chimney Fire-place, in the thick walls of which no less than six vertical flues are concealed, which carry off the smoke from the boilers and stew-pans into the Chimney.

The smoke from the fire which heats the large boiler P, (which boiler is  $32\frac{1}{2}$  inches in diameter,) on quitting its Fire-place, goes off in four separate branches, which soon unite, and forming one canal, rises up under the middle of the bottom of the neighbouring large boiler Q—makes one complete turn under that boiler, and, passing from thence towards the centre of the mass of brick-work, circulates in canals divided into several branches under an iron plate that forms the bottom of an oven, which is situated under the hearth of the open chimney Fire-place. From under the bottom of this oven this smoke goes off obliquely, and, entering the bottom of the vertical canal p, goes off into the Chimney. The principal use of this oven is to dry the wood that is used as fuel in the Kitchen. The large boiler Q, that is heated by this smoke, is designed for warming water for the use of the Kitchen, and for various other purposes for which hot water is occasionally used in the Hospital.

The boiler P is principally used in preparing food for the children in the Hospital.

The smoke from the fire which heats the boiler R, passing off in a canal which leads to the boiler S, there separates, and passing round the sides of the boiler S, and under a small part of its bottom, unites again, and passes off into the chimney by the vertical canal r. The heat in this smoke, though it is sufficient to *warm* the water in the boiler S, is not sufficient to make it boil. In order that the contents of this boiler may occasionally be made boiling hot, the boiler has a small Fire-place of its own, situated immediately under the middle of its bottom; and when the water in the boiler has been previously made warm by the smoke from the boiler R, a very small fire made under it, in its own separate Fire-place, will make it boil. The smoke from this Fire-place goes off by its own separate canal into the vertical canal s, so that it does not interfere at all with the smoke from the Fire-place of the boiler R; and in consequence of this arrangement, the heating of the boiler S, by the smoke from this neighbouring Fire-place and by its own fire, may be going on at the same time.

The smoke from the small boiler T, and from the stewpans U and W, goes off immediately by separate horizontal canals into their separate vertical canals (*t u* and *w*) that open into the chimney at the height of about 15 inches above the mantle of the open chimney Fire-place; and all the vertical canals, by which the smoke goes into the chimney, are furnished with dampers.

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The side *bc* of the mass of brick-work is placed against the middle of one side of the Kitchen, which is a large room ; and the walls of the open chimney Fire-place *g h i k* are carried up perpendicularly to the cieling of the room. The hearth *l m n o* is on a level with the top of the brick-work in which the boilers are set.

As the principal boilers are deep, in order to provide sufficient room for them, and a sufficient depth for their ash-pits, the foundation of the quadrangular mass of brick-work *a b c d* was raised 16 inches above the pavement of the Kitchen, and on the three sides of the mass of brick-work *a b*, *a d*, and *d c*, which project into the room, there are two steps, 8 inches in height each, which extend the whole length of each of those sides ; and for greater convenience in approaching the boilers, the uppermost step is made two feet wide, and the area *y* is on a level with the top of this wide step. The ash-pit doors of the principal boilers are placed in the front of this step, and the bottoms of the passages or door-ways into their Fire-places by which the fuel is introduced, are situated just on a level with its upper surface.

The mass of brick-work in which the boilers are placed, is 10 feet 9 inches long, and 8 feet 2 inches wide ; and it is elevated to the height of about 3 feet 2 inches above the top of the upper broad step, by which it is surrounded on three sides, and on which it appears to stand.

*Description of the Kitchen of the HOUSE OF CORRECTION at MUNICH.*

PLATE IV. Fig. 7, and PLATE V. Fig. 8 and 9, represent the plans and sections of this Kitchen.

Fig. 7. represents the ground plan of the brick-work in which the boilers, &c. are set, or rather an horizontal section of the brick-work at the level of the Fire-places, and of the canals for carrying off the smoke. In this Kitchen the fires are not made on circular iron-grates, as in that just described, but the fuel is burnt on grates or bars composed of bricks set edgewise, as may be seen by the plans. (See *b b b*, &c. Fig. 7.)

The two principal boilers (*ll*, Fig. 9.) are quadrangular, each being 3 feet long, 2 feet wide, and fifteen inches deep, furnished with wooden covers moveable on hinges; and they are both heated by one fire. That which is situated in the front of the brick-work, and immediately over the fire, is used for making soup; while the other, which is placed very near it, and on the same level, is used for boiling meat, potatoes, greens, &c. in steam. A small quantity of water (about an inch in depth) being put into the second boiler, the smoke from the first, which passes in flues under the second, soon causes this water to boil, and fills the boiler with hot steam. The steam from the first boiler is also carried into the second by means of a  
tube

tube about  $\frac{3}{4}$  of an inch in diameter, furnished with a cock, which forms a communication between the two boilers just below the level of their brims. This tube of communication is not expressed in the Plates.

The smoke having quitted the second boiler, rises up obliquely to the level of the top of the mass of brick-work in which the before-mentioned boilers are set, and then circulates under a quadrangular copper vessel, (expressed by dotted lines at A, Fig. 8,) 27 inches long, 19 inches wide, and 20 inches deep, destined for containing warm water for the use of the Kitchen. As this vessel stands higher than the tops of the boilers, it is found to be very convenient for filling them with water; and as this water is kept warm by the smoke, this arrangement produces a considerable economy of fuel as well as of time. The water is drawn off from this vessel, for use, by means of a brass cock, which is not expressed in the drawing; and it is supplied with water from a neighbouring reservoir, the entrance of the water being regulated by a regulating cock, or valve, furnished with a swimming ball.

The smoke, after it has circulated in flues under this vessel, goes off into a vertical canal which conducts it into the chimney. This vertical canal, together with three others designed for a similar use, (see *d d d d*, Fig. 7, and Fig. 9,) are situated in the thick walls of an open chimney Fire-place, (*n*, Fig. 8,) the hearth of which is on a level with the top of the mass of brick-work in which the boilers



are set. An horizontal section of these four vertical flues, taken at the height of 3 inches above the level of the hearth; and also an horizontal section of the brick-work of a roasting-machine, (B, Fig. 8 and 9,) situated on the left of this open chimney Fire-place, are distinctly represented in the Figure 9.

Under the hearth of the Fire-place there is an open vault which serves as a magazine for fuel; and in the front wall of the Fire-place, above the mantle, just under the ceiling of the room, there are two openings into the chimney, by which the steam that rises from the boilers escapes into the chimney and goes off with the smoke.

The manner in which the flues are constructed under the different boilers, and the horizontal canal for carrying off the smoke from the round boilers into the chimney, are shewn in the fig. 7. The ash-pit doors to the two principal round boilers, which are expressed by dotted lines, are opposite to E and F, Fig. 7.

The ash-pit door belonging to the Fire-place of the large quadrangular boilers is situated opposite to G, Fig. 7. The reason why these ash-pit doors were not placed immediately under their Fire-place doors is because there was not room for them in that situation, owing to the pavement of the area between the boilers being raised one step higher than the floor of the kitchen, which was done for the convenience of the Cook.

The openings for introducing the fuel into the Fire-places are conical holes in square tiles, closed with earthen stoppers, (see page 30, Essay VI.)

Though



Though these tiles are not particularly distinguished in these plates, the stoppers which close their conical openings are shewn. As these tiles are so worked into the mass of the brick-work as to make a part of it, and as they are plastered and white-washed in front, it is not easy to distinguish them from the bricks when the work is finished. Their joinings with the bricks in front could not therefore with propriety be marked in any of these plans.

Although the roaster belonging to the kitchen we are describing is not seen, yet the mass of brick-work in which it is fitted up appears on the left hand side of the open chimney Fire-place in Fig. 8; and a bird's-eye view of its Fire-place, and of the projecting edges of the bricks on which it rests, are seen in the figure 9.

*Description of the new Kitchen in the MILITARY HOSPITAL at MUNICH.*

PLATE VI. Fig. 10 and 11, and PLATE VII. Fig. 12.

The mass of brick-work in which the boilers, the roaster, the stewpans, &c. are set, occupies one corner of the Kitchen, extending  $11\frac{1}{2}$  feet on one side of the room, and 13 feet 7 inches on the other. The greatest width of the mass of brick-work (from A to B, or from C to D) is  $50\frac{1}{2}$  inches, and its height from the floor 36 inches. The circular area (E, Figures 9 and 10) in the angle of the mass of brick-work is 6 feet  $8\frac{1}{2}$  inches

inches in diameter ; and it is raised one easy step, or about 5 inches above the level of the floor of the room. There is an open chimney Fire-place of a peculiar form (F, Fig. 10) in the corner of this Kitchen, the hearth of which is on a level with, or rather makes a part of the upper surface of the mass of brick-work. The side-walls of this open chimney Fire-place are hollow, (see G and H, Fig. 10,) and serve as canals for carrying off the smoke from the boilers into a chimney, which is situated quite in the corner of the room. These canals open into the Chimney about 15 inches above the level of the mantle.

The smoke goes off from each Fire-place by two separate and very narrow horizontal canals into larger common canals, (see I and K, fig. 9,) which conducts it to the Chimney ; and the openings of these narrow canals are occasionally closed more or less by means of small pieces of brick or of earthen-ware, which serve instead of dampers, but which are not expressed in the Plates. The fires all burn on flat grates, composed of bricks, or thin tiles set edge-wise. To save expence the covers of the boilers and stewpans were all made of wood. The oblong quadrangular vessel, (see L, Figures 10 and 11,) which is made of copper, and has a door above moveable on hinges, is destined for containing warm water for the use of the Kitchen, and is heated by the smoke from all the neighbouring closed Fire-places.

The Fire-place of the roaster is seen in Figure 9 (M) ; a bird's-eye view of the top of the roaster appears

appears in Figure 10, and a vertical section of it and of its flues are faintly marked by dotted lines in Fig. 11.

The two large shallow stewpans, (N, O, Fig. 10,) vertical sections of which, and of their Fire-places, are faintly marked by dotted lines in Fig. 11, are constructed of hammered iron, and are used principally for cooking steam dumplings, (dampf-nudels,) a kind of food in great repute in Bavaria.

When any thing is to be fried or broiled, a fire is made on the hearth of the open chimney Fire-place. Under this hearth there is a small vault which serves for holding the wood that is wanted for fuel; but it would have been much better if that space had been occupied by two circular closed Fire-places, so constructed as to be used occasionally for a frying-pan or a gridiron.

*Description of a detached part of the Kitchen of the  
Military Academy at Munich.*

PLATE VII. Fig. 13. This figure is the ground plan of a mass of brick-work occupying a space about 6 feet 9 inches square, measured on the floor, in one corner of the room, in which two of the principal boilers belonging to the kitchen, and three large stewpans, are fixed.

A and B are two steps, each 8 inches high, and the upper (flat) surface of the mass of brick-work, in which the boilers are set, and which is 45  
inches

inches wide, is just 30 inches above the level of the upper surface of the step B.

Neither the boilers nor stewpans are shewn in this plan, but their circular fire-places are represented; as also their circular dishing iron grates, on which the fuel is burnt, and the horizontal canals by which the smoke passes off into the chimney.

The smoke divides under each of the two principal boilers, and passes off in two canals situated on opposite sides of the Fire-place; which canals, however, unite and form one single canal at a small distance from the boiler. In the Fire-places of the stewpans the smoke does not divide in this manner; but the Fire-place is so constructed, that the flame makes one complete turn round the stewpan before it goes off into the horizontal canal leading to the chimney.

The opening by which the fuel is introduced into the Fire-place of each of the two large boilers is closed by a conical stopper, (constructed of fire-stone,) represented in the figure, immediately under which stopper the (register) door of the ash-pot is situated.

The ash-pit of each of the Fire-places of the stewpans is furnished with a register door. The passages into these ash-pits are expressed in the figure by dotted lines. The fuel (which is small pieces of wood about 5 inches in length) is introduced into the Fire-place from above, by removing the stewpan for a moment for that purpose.

The

The chimney C, by which the smoke goes off, is situated in a corner of the room, and when it is swept, the chimney-sweeper enters it by a doorway, which is situated in front, just above the level of the upper surface of the mass of brick-work, and which is closed by an iron door.

Each of the horizontal canals by which the smoke is carried off from the Fire-places of the two large boilers into the chimney, is furnished with a damper, which is faintly marked in the figure. Each of the horizontal canals, which carry off the smoke from the Fire-places of the stewpans, is likewise furnished with a damper, but, to avoid confusion, they are not expressed in the engraving.

The bottoms of the ash-pit doors of the Fire-places of the three stewpans, are on a level with the upper surface of the step B; but the bottoms of the ash-pit doors of the Fire-places of the two large boilers are on a level with the pavement of the kitchen.

The two large boilers (which are constructed of sheet copper, tinned,) are 22 Rhinland inches in diameter above,— $19\frac{1}{4}$  inches in diameter below,—and 24 inches deep. They weigh each 62 lbs. Avoirdupois, and contain 28 wine gallons. The circular dishing grates belonging to their Fire-places are each 10 inches in diameter, measured externally, and the Fire-place, properly so called, or the cavity in which the burning fuel is confined, is 10 inches in diameter below, 18 inches in diameter above, and  $8\frac{1}{2}$  inches deep.



The largest stewpan is 12 inches in diameter, and 4 inches deep; and the two others are each 11 inches in diameter, and 4 inches deep.

The Fire-places belonging to the stewpans are cylindrical,—5 inches deep, and 6 inches in diameter, and are furnished with circular dishing grates.

Each of the large boilers is furnished with a circular wooden rim, 2 inches wide, and 2 inches thick, which is accurately fitted to the brim of the boiler; and a circular wooden cover, consisting of three pieces of deal board attached to each other by two pairs of hinges, closes the boiler by being fitted accurately to the upper surface of its circular wooden rim.

One of the three pieces of board, which together form the flat circular cover of the boiler, is firmly fastened down to the wooden rim of the boiler, by means of two small hooks of iron; and from the middle of this part of the cover, so fastened down, a long tin tube, about  $1\frac{1}{4}$  inches in diameter, rises up perpendicularly to the ceiling of the room, and carries off the steam from the boiler out of the kitchen.

As the cover of the boiler is composed of three flat pieces of board united by hinges, and as the cover, so formed, is merely laid down on the flat surface of the wooden rim which is connected with the brim of the boiler, it might very naturally be expected that some of the steam would be forced through between the joinings of the cover, or between



tween the cover and the wooden rim ; but this is what never happens :—So far from it, steam seldom comes into the room even when the cover of the boiler is in part removed, by laying back the first division of it upon the second—so strong is the draught of the steam tube.

This phenomenon, which rather surprised me when I first observed it, was of considerable use to me ; for it led me to discover the utility of dampers in the tubes, or chimnies, that are destined for carrying off the steam from boilers, and more especially from such boilers whose covers are not perfectly air-tight. If these steam-chimnies are of any considerable length, they cannot fail to occasion a strong draught through them, which will have a tendency to cause the cold air of the atmosphere to press in by every crevice between the brim of the boiler and its cover ; which streams of cold air being precipitated upon the surface of the boiling liquid, will be there warmed ; and then passing off rapidly by the steam-chimney, will occasion a very considerable loss of heat.

The rule for regulating the damper of the steam-chimney of a boiler, whose cover is not steam tight, is this ;—close the damper just so much, that closing it any more would cause some steam to be driven out between the joinings of the brim of the boiler and its cover. When this is done, it is evident that little or no cold air can enter the boiler by any small crevices in its cover that may remain open, consequently little or no  
heat

heat will be carried off by the air of the atmosphere from the surface of the hot liquid.

I have been the more particular in explaining this matter, as I am persuaded that a great deal of heat is frequently lost in boiling and evaporating liquids, by causing or permitting the cold air of the atmosphere to come into contact with the surface of the hot liquid.

Some, I know, are of opinion, that a stream of fresh air, or a wind, which is made to pass over the surface of a liquid that is evaporated by boiling, tends rather to increase the evaporation than to diminish it; but it appears to me that there are strong reasons to conclude that this opinion is erroneous. A very simple experiment, which I propose to make, and which others may perhaps be induced to make before I can find leisure to attend to it, will determine the fact.

The large boiler belonging to the Fire-place, which is situated on the left hand in the mass of brick-work above described, is that which was used in the Experiment mentioned in the ninth page of my Sixth Essay.

It was once my intention to have published drawings and descriptions of every part and detail of the kitchen of the Military Academy at Munich, and also that of the House of Industry in that city; but as enough has already been said in this and in my Sixth Essay to give clear and distinct ideas of the fundamental principles on which all the essential parts of the machinery in those  
kitchens

kitchens were constructed ; and as the peculiar arrangement of a kitchen must ever depend much on its size, and on the variety and kinds of food that are to be cooked in it, to avoid being tedious and tiresome to my readers, I have, after mature deliberation, concluded that it will be best to suppress these details.

Having now finished all the descriptions which I think it useful to publish of the various public and private kitchens that have been constructed under my direction in foreign countries, and having explained in the most ample manner in this Essay, and in my other writings on the Management of Fire, all the leading principles according to which, in my opinion, kitchens and fire-places of all kinds should be constructed, I shall in the next place proceed to show in what manner my plans may be so modified and accommodated to the opinions and practices in this country as to remove the objections that will probably be made to them, and facilitate their gradual introduction into general use.

I am well aware that it is by no means enough for those who propose improvements to the public to be in the right in regard to the intrinsic merit of their plans : much must be done to prepare the way for, and to facilitate their introduction, or all their labours will be in vain.

## C H A P. III.

*Of the alterations and improvements that may be made in the Kitchen Fire-places now in common use in Great Britain.—All improvement in Kitchen Fire-places impossible, as long as they continue to be encumbered with smoke-jacks.—They occasion an enormous waste of fuel.—Common jacks, that go with a weight, are much better.—Ovens and boilers that are connected with a kitchen range should be detached from it, and heated each by its own separate fire.—The closed Fire-places for iron ovens and roasters can hardly be made too small.—Of the various means that may be used for improving the large open fire-places of kitchens.—Of the cottage Fire-places now in common use, and of the means of improving them.—Of the very great use that small ovens constructed of thin sheet iron would be of to cottagers.—Of the great importance of improving the implements and utensils used by the poor in cooking their food.—No improvement in their method of preparing their food possible without it.—Description of an oven suitable for a poor family, with an estimate of the cost of it.—Of nests of three or four small ovens heated by one fire.—Of the utility of these nests of ovens in the  
kitchens*

*kitchens of private families.—They may be fitted up at a very small expence.—Occasional remarks respecting the materials proper to be used in constructing the sides and backs of open chimney Fire-places.*

THE Kitchen Fire-place of a family in easy circumstances in this country consists almost universally of a long grate, called a Kitchen-Range, for burning coals, placed in a wide and deep open chimney with a very high mantle. The front and bottom bars of the grate are commonly made of hammered iron, and the back of the grate (which usually slopes backwards) of a plate of cast iron; and sometimes there is a vertical plate of iron, moveable by means of a rack in the cavity of the grate, by means of which plate the capacity, or rather the length of that part of the grate that is occupied by the burning fuel, may occasionally be diminished. At one end of the grate there is commonly an iron oven, which is heated by the fire in the grate; and sometimes there is a boiler situated in a similar manner at the other end of it. To complete the machinery, (which in every part and detail of it seems to have been calculated for the express purpose of *devouring fuel*,) a smoke-jack is placed in the Chimney!

I shall begin my observations on the smoke-jack.

No human invention that ever came to my knowledge appears to me to be so absurd as this. A wind-mill is certainly a very useful contrivance,



but were it proposed to turn a wind-mill by an artificial current of air, how ridiculous would the scheme appear ! What an enormous force would necessarily be wasted in giving velocity to a stream of air sufficient to cause the mill to work with effect ! A smoke-jack is, however, neither more nor less than a wind-mill, carried round by an artificial current of air : and to this we may add, that the current of air which goes up a chimney, in consequence of the combustion of fuel in an open Chimney Fire-place, is produced in the most expensive and disadvantageous manner that can well be imagined. It would not be difficult to prove, that much less than *one thousandth* part of the fuel that is necessary to be burnt in an open Chimney Fire-place, in order to cause a smoke-jack to turn a loaded spit, would answer to make the spit go round, were the force evolved in the combustion of the fuel properly directed ; through the medium of a steam-engine, for instance.

But it is not merely the waste of power, or of mechanical force, that unavoidably attends the use of smoke-jacks, that may be objected to them ; they are very inconvenient in many respects : they frequently render it necessary to make a great fire in the kitchen, when otherwise a great fire would not be wanted : they very frequently cause chimnies to smoke, and always render a stronger current of air up the chimney necessary, than would be so merely for the combustion of the fuel wanted for the purposes of cooking ; consequently they in-  
crease



crease the currents of cold air from the doors and windows to the Fire-place: and lastly, they are troublesome, noisy, expensive, frequently out of order, and never do the work they are meant to perform with half so much certainty and precision as it would be done by a common jack, moved by a weight or a spring.

There is, I know, an objection to common jacks that is well founded, which is, that they require frequent winding up; but for this there is an easy remedy. A jack may without any difficulty (merely by using a greater weight, and a greater combination of pullies) be made to run almost any length of time;—a whole day for instance, or even longer; and if it should be necessary, the weight may be at a considerable distance from the kitchen. It may indifferently be raised up into the air,—descend into a well,—or may be made to descend along an inclined plane; and but little ingenuity will be required to contrive and dispose of the machinery in such a manner as to keep it out of the way, and if it should be required, completely out of sight: and with regard to the winding up of such a jack as I here recommend, (that is, to go a whole day,) it may easily be done by any servant of the house, in less than five minutes.

Incomparably less labour will be required to wind up the weight of a common jack than to bring coals to feed the fire that is requisite to make a smoke-jack go.

I know that it is said in favour of smoke-jacks, that all the fire that is required to make them perform would be necessary in the kitchen for other purposes, and consequently that they occasion no additional expence of fuel; but that this statement is very far indeed from being accurate will be evident to any person who will take the trouble to examine the matter with care. That the sails of a smoke-jack will turn round with the application of a very small force, when the pivots, on which its axle-tree rests, are well constructed, and when its motion is not impeded by any load, is very true; but it requires a very different degree of force to move it, when it is obliged to carry round one, or perhaps two or three loaded spits. Even the heat given off to the air by the kitchen range in cooking, after the fire is gone out, will sometimes keep up the motion of the sails of the smoke-jack for many hours. But what a striking proof is this of the enormous waste of fuel in kitchens in this country!

Would to God that I could contrive to fix the public attention on this subject.

Nothing surely is so disgraceful to society, and to individuals, as unmeaning wastefulness.

But to return to the attack of my smoke-jack;—which (although it be a *wind-mill*) is certainly not a *giant*, and cannot be personally formidable, however it may expose me to another species of danger.

There

There is one objection to smoke-jacks that must be quite conclusive wherever the improvements I have recommended, and shall recommend, in Kitchen Fire-places, are to be introduced. Where smoke-jacks exist, these improvements cannot be introduced, it being quite impracticable to unite them.

On a supposition that I have gained my point, and that the smoke-jack is to be removed, I shall now proceed to propose several alterations and improvements that may be made in the Kitchen Range.

And, first, all ovens, boilers, steam-boilers, &c. which are connected with the back and ends of the range, and heated by the fire made in the grate, should be detached from it, and for each of the ovens, boilers, &c. a small, separate, closed Fire-place must be constructed, situated *directly under* the oven or boiler, and furnished with a separate canal for carrying its smoke into the Kitchen Chimney, which separate canal may open into the Chimney about a foot above the level of the mantle.

There is nothing so wasteful as the attempt to heat ovens and boilers by heat drawn off laterally from a fire in an open grate. The consumption of fuel is enormous, to say nothing of the expence of the machinery, and the inconvenience that must frequently arise from the heat being forcibly drawn away sidewise under an oven or boiler, when it is wanted elsewhere.

The separate closed Fire-place under iron ovens and roasters must be made *very small*, otherwise the cook or his assistants will sometimes, in the hurry of business, make too large a fire; the consequences of which will be the spoiling of the food, and the burning and destroying of the oven or roaster.

Almost all the roasters that have been put up in England have been spoiled in consequence of their Fire-places being made too large; and not one has ever received the slightest accident or injury, or failed to perform to entire satisfaction, that has been heated by a very small fire, and never over-heated.

The Fire-place for an oven or roaster of sheet-iron, from 18 to 20 inches wide, and from 24 to 30 inches long, should never be more than 6 inches wide,—6 inches deep,—and about 9 or at most 10 inches long; and this Fire-place should seldom be half-filled with coals. If the oven or roaster be set in such a manner that the flame or smoke from the fire must necessarily spread round it and embrace it on every side, there will be no want of heat for any of the common purposes of cookery, and its intensity may at all times be regulated by means of the damper in the Chimney, and the Register in the ash-pit door.

It is not easy to imagine how much the business of cooking is facilitated by making the machinery so perfect, that the quantity of heat may at any time be regulated with certainty merely by registers

ters and dampers, and without adding to or diminishing the quantity of fuel in the Fire-place. It is on these advantages, and the numerous other conveniences that will result from them, that my hopes are principally founded of gaining over the cooks, and engaging their cordial assistance in bringing forward into general use the improvements I recommend. I am well aware of their influence, and of the importance of their co-operation.

When all the ovens and fixed boilers are detached from the Kitchen range, then, and not before, measures may be taken with some prospect of success for improving the Kitchen Fire-place, so as to economise fuel, and prevent the Kitchen Chimney from smoking, if it has that fault; and the measures proper to be adopted for obtaining those ends must depend principally on the size, or rather on the width of the open fire that will be wanted in the Kitchen. Where the family is small, and where great dinners are seldom or never given, and especially where closed roasters are introduced, a small Fire-place, and consequently a narrow grate, will answer every purpose that can be wanted; and the Fire-place of the Kitchen may be fitted up nearly upon the principles laid down in my Fourth Essay, on the Construction of open Chimney Fire-places.

The Kitchen of Mr. Summers, Ironmonger, of New Bond Street, (No. 98,) has been fitted up in  
this



this manner, and has been found to answer perfectly well.

But if it be necessary to leave the grate of the Kitchen Range with its width undiminished, in order that a wide fire may occasionally be lighted in it, this can best be done in the manner that was lately adopted in altering and fitting up the Kitchen in the house of the Countess of Morton in Park Street. The range being suffered to remain (or rather the front and bottom bars of the grate only, for the iron plate that formed the back of the range was taken away);—the range, which is about five feet long, was divided into three unequal parts, which parts were built up with hard fire-bricks in such a manner as to form three distinct Fire-places, the one contiguous to the other, and separated from each other by divisions so thin in front, that when fires are burning in them all it appears like one fire, and has all the effect of one fire in roasting meat that is put before it. Each Fire-place is, however, perfectly distinct from the others, and has its own distinct coverings, (which are oblique,)—back, throat, &c. though the same front bars, which are of hammered iron, and made very strong, run through them all.

When a very small fire is wanted, (merely for boiling a tea-kettle, for instance,) it is kindled in the *first* or smallest Fire-place: when a little larger fire is necessary, it is made in the *second* Fire-place, which



which is at the opposite end of the range : when a still larger fire is required, it is made in the *third* Fire-place, which occupies the middle of the range. If a large fire in the fourth degree is wanted, two neighbouring fires are kindled in the *first* and *third* Fire-places ; if in the fifth degree, the two contiguous fires are lighted in the second and third Fire-places ; and when the greatest fire that can be made is wanted, all the three Fire-places are at the same time filled with burning fuel.

In cases where a single open Chimney Fire-place of a moderate size, that is to say, from 18 to 20 inches in width, might sometimes be too small, and a very wide fire, like that just described, would never be wanted, I would advise the construction of two separate but adjoining Fire-places, the one about 12 inches, and the other about 18 or 20 inches in width. These would, I imagine, answer every purpose for which an open fire in the kitchen could be wanted by a large family, even though they should (contrary to all my recommendations) continue to roast their meat upon a spit.

That I am not unreasonable enough to expect that all my recommendations will immediately be attended to, is evident from the pains I take to improve machinery now in use, of which I do not approve, and which is perfectly different from that I am desirous to see introduced.

When my roasters shall become more generally known, and the management of them better understood,

stood, I have no doubt but that open Chimney Fire-places, and open fires of all descriptions, will be found to be much less necessary in kitchens than they now are.

I am even sanguine enough to expect that the time will come when open fires will disappear, even in our dwelling rooms and most elegant apartments. Genial warmth can certainly be kept up, and perfect ventilation effected much better without them than with them; and though I am myself still child enough to be pleased with the brilliant appearance of burning fuel, yet I cannot help thinking that something else might be invented equally attractive to draw my attention and amuse my sight, that would be less injurious to my eyes,—less expensive,—and less connected with dirt, ashes, and other unwholesome and disagreeable objects.

It is very natural to suppose that those nations who inhabit countries where the winter is most severe, must have made the greatest progress in contriving means for making their dwellings warm and comfortable in cold weather; and when, in milder climates, the growing scarcity of fuel has rendered the saving of that article an object of rational economy, it appears to me to be wise to search *there* for the means of doing it, where necessity has long since rendered the use and highest possible improvement of those means indispensable. And the truly liberal,—that is to say, the enlightened, just, and generous,—feel no difficulty in acknowledging

ing the ingenuity and industry of their neighbours, and no humiliation in adopting their useful inventions and improvements.

BEFORE I finish this publication I must say a few words on the construction of *Cottage Fire-places*. It is, I am sensible, a long time since I promised to publish an Essay on that subject, and still mean to do so; but a variety of weighty considerations have engaged me to postpone the putting of that Essay out of my hands. I conceived the subject to be of very great importance, and wished to have time to make myself fully acquainted with the present state of cottages, and of the different kinds of fuel used in them in different parts of these kingdoms.—I had with pain observed the numerous mistakes that have been made in altering Chimney Fire-places on the principles recommended in my Fourth Essay, and on that account I was very desirous of deferring the publication of my directions for constructing Cottage Fire-places, till I could inform the public where Cottage Fire-places, constructed on the principles recommended, might be seen.

I hope and trust that in the arrangement of the repository of the Royal Institution, now sitting up in this metropolis, an opportunity will be found for exhibiting Cottage Fire-places on the most perfect plans, as also of showing many other mechanical contrivances that may be of general utility.

Cottage

Cottage Chimnies, as they are now commonly constructed in most parts of Great Britain, have a very wide open Fire-place, with a high mantle, and large chimney corners, in which the children frequently sit on little stools, when in cold weather they hover round the fire. These chimney corners are very comfortable; and except the whole room could be made equally so, it would certainly be a pity to destroy them; but this, I am persuaded, may easily be done: in the mean time, much may be done to make cottages warm and comfortable, merely by a few simple alterations in their present Fire-places.

As the principal fault of these Fire-places is the enormous width of the throats of their chimnies, which frequently occasions their smoking, and always gives too free a passage for the warm air of the room to escape up the chimney, a smaller Fire-place may be constructed in the midst of the larger one, and the little chimney of this small Fire-place being carried up perpendicularly in the middle of the large Fire-place, the large chimney corners, without being destroyed, may be arched over and closed in above, so as to leave no passage in those parts for the escape of the warm air of the room into the chimney, and from thence into the atmosphere.

The back of the old chimney may serve for a back to the new Fire-place, and the jambs of the new chimney need not project forward beyond the back more than 12 or 15 inches; so that the new chimney,

chimney, and every part of it, may be completely included within the opening of the old Fire-place. This is to be done in order to preserve the old chimney corners; but in cases where the opening of the old Fire-place is not sufficiently wide, high, and deep, to permit of the leaving of chimney corners sufficiently spacious to be useful, it will be best to sacrifice these corners, and to proceed in a different manner in constructing the new Fire-place.

In this last case the back of the new Fire-place should be brought forward, and the new work should be executed agreeably to the directions contained in my Fourth Essay for the construction of open Chimney Fire-places. If void spaces should remain on the right and left of the new jambs, they will be found useful for various purposes.

It is of so much importance to facilitate the means of cooking to the poor, and enabling them to prepare food in different ways, that I think it extremely desirable that each cottager should have an *iron pot* or *digester*, so contrived as to be used occasionally over his open fire, or, what will be much more economical, in a small closed Fire-place, which may be made with a few bricks on one side of his open Fire-place.

But what would be of more use, if possible, to a poor family, even than a good boiler, would be a *small oven* of sheet iron, well put up in brick-work. Such an oven would not cost more than a  
few



few shillings; and if properly set, would last for many years without needing any repairs. It would answer not only for baking household bread and cakes, but might likewise be used with great advantage in cooking rice puddings, potatoe pies, and many other kinds of nourishing food of the most exquisite taste, that might be prepared at a very trifling expence.

It is in vain to expect that the poor should adopt better methods of chusing and preparing their food, till they are furnished with better implements and utensils for cooking.

I put up an oven like that I now recommend last winter in my lodgings at Brompton, and have made a great number of experiments with it, from the results of which I am fully persuaded of its utility. I pulled it down on removing into the house I now occupy, but mean to put it up again as soon as my kitchen shall be ready to receive it. As I put up this oven merely as an experiment, in order to ascertain by actual trials how far it might be useful to poor families, the oven was made small, and it was set in the cheapest manner, merely with common bricks and mortar, without any iron or other costly material. The grate of the closed Fire-place (which was 5 inches wide and about 8 inches long) was constructed of three common bricks placed edgewise, and a sliding brick was used for closing the door of the Fire-place, and another for a register to the ash-pit door-way. The oven,  
which



which is of thin sheet iron, is  $18\frac{1}{2}$  inches long, 12 inches wide, and 12 inches high,—and it weighs just  $10\frac{1}{2}$  lb. exclusive of its front frame and front door, which together weigh  $6\frac{1}{4}$  lb.

For a small family the oven might be made of a smaller size,—11 inches wide for instance, 10 inches high, and 15 inches long; and it is not indispensably necessary that it should have either a front frame or a front door of iron. It might be set in the brick-work without a frame, perfectly well; and a flat twelve-inch tile, or a flat piece of stone, or even a piece of wood, placed against its mouth, might be made to answer instead of an iron door.

The only danger of injury to these ovens from accident to which they are liable, is that arising from carelessness in making too large a fire under them. They require but a very small fire indeed, and a large one is not only quite unnecessary, but detrimental on several accounts. For greater security against accidents from too strong fires, I would advise the Fire-place to be made extremely—I had almost said—ridiculously small; not more than from 4 to 5 inches wide, from 6 to 8 inches long, and about 5 inches deep; and I would place the bottom or grating of the Fire-place 11 or 12 inches below the bottom of the oven. For still greater security, the bottom of the oven, immediately over the fire might, if it should be found necessary, be defended by a thin plate of cast, hammered, or sheet iron, full of small holes (as large as peas), placed about half an inch from the bottom

of the oven, and directly below it : but if any common degree of attention be used in the management of the fire, this precaution will not, I am persuaded, be necessary.

In setting these ovens, care must be taken that room be left for the flame and smoke to come into contact with the oven, and surround it on every side ; and it can hardly be necessary to add, that a canal must be made by which the smoke can afterwards pass off into the chimney.

I once imagined that small ovens for poor cottagers might be made very cheap indeed, by making only the bottom of the oven of iron, and building up the rest with bricks ; but on making the experiment, it was not found to answer. I caused several ovens on this principle to be constructed in my kitchen, and made many attempts to correct their faults ; but I found it impossible to heat them equally and sufficiently. I then altered my plan, by making both the bottom and the top of sheet iron. But this even did not answer. It might answer, and certainly would answer, for a perpetual oven, like that which I caused to be made in the House of Industry at Dublin ; but if an oven of this kind is ever suffered to become cold, it will require a long time to heat it again, which is a circumstance that renders it very unfit for the use of a poor family. The ovens I have recommended, constructed entirely of thin sheet iron, have the advantage of being heated almost in an instant, and the heat which penetrates the walls of their closed

Fire-

Fire-places being gradually given off after all the fuel is burnt out, keeps them hot for a long time. Care should, however, always be taken to keep these ovens well closed when they are used, and to leave only a very small hole, when necessary, for the escape of the generated steam or vapour.

For larger families the oven may be made larger in proportion; or, what will be still more convenient, a nest of two, three, or four small ovens, placed near to each other, may be so set in brick-work as to be heated by one and the same fire.

A nest of four small ovens, set in this manner, was fitted up in the kitchen of the Military Academy at Munich, and found very useful: they were rectangular, each being 10 inches wide, 10 inches high, and 16 inches long; and they were placed two a-breast in two rows, one immediately above the other, the sides and bottoms of neighbouring ovens being at the distance of about  $1\frac{1}{2}$  inch that the flame and smoke which surrounded them on every side, might have room to pass between them. The Fire-place was situated immediately below the interval that separated the two lowermost ovens, at the distance of about 10 inches below the level of their bottoms; and by means of dampers the flame could be so turned and directed as to increase or diminish the heat in any one or more of the ovens at pleasure.

These four ovens were furnished with iron doors, moveable on hinges, which, in order that they

might not be in the way of each other, opened two to the right and two to the left.

In a large kitchen, where a variety of different kinds of food are baked at the same time, or on the same day, it is easy to perceive, that a nest of small ovens must be very useful, much more so than one large oven equal in capacity to them all; for besides the inconvenience in cooking a variety of different things in the same oven, that arises from the promiscuous mixture of various exhalations and smells, the process going on in one dish must often be disturbed by opening the oven to put in, or take out another, and the heat can never be so regulated as to suit them all.

But the cook of the Military Academy at Munich finds the nest of ovens useful, not merely for baking: he uses them also for stewing and for boiling, with great success. A large quantity of cold liquid cannot, it is true, be heated and made to boil in a very short time in one of these ovens, but a saucepan or boiler, whose contents are already boiling-hot, being placed in one of them, a gentle boiling may be kept up for a great length of time, with the consumption of an exceedingly small quantity of fuel.

With regard to the expence or cost of such a nest of ovens, it could not, or at least ought not to be considerable. If they were each 12 inches wide, 12 inches high, and 16 inches long, they would not weigh more than 15 lb. each, their doors included;

cluded; and this would make but 60 lb. for the weight of the whole nest, supposing it to consist of four ovens. I do not know what price might be demanded by the artificers in this country, or by the trade, for work of this kind, but I should think they might well afford to sell these ovens, properly made, and ready for setting, at less than 6d. the pound, avoirdupois weight. The sheet iron would cost them in the market, at the first hand, not more than about  $3\frac{1}{2}$  d. *per* pound. The expence of setting the ovens would not be considerable, especially as only one small Fire-place would be necessary.

In some future publication, or in a subsequent part of this Essay, I shall give a design of one of these nests of ovens, with an exact estimate of the expence of it; in the mean time I will endeavour to get one of them put up for the public inspection at the Royal Institution.

I cannot close this Chapter without once more calling the attention of my reader to the necessity of furnishing the canal that carries away the smoke into the chimney with a damper. If this is not done in setting the ovens I have just been describing, it will be quite impossible to manage the heat properly. For the Fire-place of a small oven for the family of a cottager, a common brick may be made to answer very well as a damper; and, indeed, a very good damper for any small Fire-place may be made with a brick, or a tile, or a piece of stone.



If, in addition to the introduction of a good damper, care be taken to cause the smoke to *descend* about 12 or 15 inches just after it has quitted the oven (or the boiler), and before it is permitted to rise up and go off into the chimney, this will greatly contribute to the economy of fuel.

It is surely not necessary that I should again observe how very essential it is in altering open Chimney Fire-places,—whether they belong to kitchens,—to the dwelling-rooms of the opulent,—or to cottages, to build up their backs and sides,—in that part especially which contains and is occupied by the burning fuel,—with fire-bricks or with stone; and never in any case to kindle a fire against a plate of iron.

If all the metal in a register stove, except the front, and the front and bottom bars, were removed, and the back and sides built up properly with fire-bricks, or partly with fire-bricks and partly with fire-stone, it would make a most excellent Fire-place.

This last observation is, I acknowledge, in some degree foreign to my present subject; but as it is well meant, I hope it will be well received.

In a Supplementary Essay now preparing for the press, in which will be published such additional remarks and observations to all my former Essays as may be necessary to their complete explanation and elucidation, I shall take occasion to enter fully into the subject of Chimney Fire-places, and shall endeavour to show, at some length, why it is improper  
and



and ill-judged to construct the sides and backs of their grates of iron, or of any other metallic substance.

In a Second Part which will be added to this (Tenth) Essay, particular directions will be given for constructing boilers, steam dishes, ovens, roasters, and various other implements and utensils used in cookery; and a detailed plan will be laid before the public for improving the kitchen utensils of cottagers and other poor families.

I have been induced to reserve these various matters for a separate publication, in order to accommodate my writings as much as is possible to the convenience of the various classes of readers into whose hands they are likely to come. The Plates, which were indispensably necessary to elucidate the descriptions contained in the preceding Chapters, (which have been admirably executed by that excellent artist Lowry,) could not fail to enhance very considerably the price of this publication, and on that account I was desirous to detach and publish separately all such popular parts of the subjects I have undertaken to treat in this Essay, as appeared to me to bid fair to be most read, and to be of most general utility.

Whether the reader agrees with me or not in respect to the validity of the reasons which have determined my judgment on this occasion, I hope and trust that he will do me the justice to believe, that I have no wish so much at my heart as to

render my labours of some real and lasting utility to mankind. How happy shall I be when I come to die, if I can *then* think that I have lived to some useful purpose!

THE END OF THE FIRST PART OF THE TENTH ESSAY.

# APPENDIX

TO THE

## FIRST PART OF THE TENTH ESSAY.

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### *An account of the expence of fitting up a small Oven.*

SINCE the foregoing sheets were printed off, I have caused a small oven of sheet iron to be made, and set in brick-work, for the express purpose of ascertaining the cost of it. This oven, which is such as would be proper for the use of a small poor family, is 11 inches wide, 11 inches high, and  $15\frac{1}{2}$  inches long; and it weighs 6 lb. 2 oz. At its mouth or opening, the sheet iron is turned back in such a manner as to form a rim, half an inch wide, projecting outwards; which rim serves to strengthen the oven, and is likewise useful in fixing it in the brick-work.

The whole oven is constructed of two pieces of sheet iron, of unequal dimensions, the largest piece (which is about  $16\frac{1}{2}$  inches wide by 45 inches long) forming the top, bottom, and two sides; and the smallest (which is about 12 inches square) forming the end. These sheets of iron are united by seams without rivets. One seam only runs through the

oven in the direction of its length, and that is situated in the middle of the upper part of it.

A good workman was employed just two hours in making this oven, but there is no doubt but the work might be done in a shorter time by a man accustomed to that kind of manufacture, especially if the proper means were used for facilitating and expediting the labour.

The sheet iron used in the construction of this oven,—which was of the very best quality,—cost 34 s. *per* gross hundred of 112 lb. which is at the rate of  $3\frac{1}{2}$  d. and  $\frac{3}{14}$  of a farthing *per* lb.—The quantity used—6 lb. 2 oz. must therefore have cost 1 s. 10 $\frac{1}{2}$  d. and  $\frac{1}{112}$  part of a farthing.

If now we allow two ounces for wastage, this will bring the quantity necessary for constructing one of these ovens to 6 $\frac{1}{4}$  lb. which quantity, at the rate above mentioned, would cost something less than 1 s. 11 d.; and if to this sum we add 1 s. for the making, this will bring the prime cost of the oven to 2 s. 11 d.

Let us allow 20 *per cent.* for the profit of the manufacturer, and still the price of the oven to buyers will be only 3 s. 6 d. \*

In order to ascertain the expence of setting one of these ovens in brick-work, I caused that above

\* The oven I have here described was made by Mr. Summers, ironmonger, of New Bond street, who, before I acquainted him with the above computations, offered to furnish these ovens in any quantities at 4 s. a-piece. This, for the offer of a manufacturer, I thought not unreasonable.

described

described to be put up in the middle of a wide chimney Fire-place in my house in Brompton-Row; and the work was executed with as much care and attention as was necessary, in order to render it strong and durable. In doing this 114 bricks were used, and something less than 3 hods of mortar; and the bricklayer performed the job in 3 hours and 10 minutes.

Three bricks set edgewise formed the grate or bottom of the Fire-place; the middle brick being placed vertically, and those on each side of it inclining a little inwards above, to give a more free passage to the falling ashes.

The entrance into the Fire-place was closed with a sliding brick, and another brick served as a register to the ash-pit door-way; a third served as a damper to the canal that carried off the smoke into the chimney; and the oven itself was closed with a twelve-inch tile.

The expence of setting this oven was estimated as follows :

	s.	d.
114 bricks, at 3s. <i>per</i> hundred	-	3 4
3 hods of mortar, at 4d.	-	1 0
1 twelve-inch tile, at 4d.	-	0 4
Bricklayer's labour	-	1 6

Total 6 2

If to this sum we add the amount of the	}	3 6
ironmonger's bill for the oven		

The whole expence will turn out	-	9 8
---------------------------------	---	-----

The

The mass of brick-work in which this oven is set is just 2 feet wide,  $19\frac{1}{2}$  inches deep, measured from front to back,—and 3 feet  $3\frac{1}{2}$  inches high. The chimney Fire-place in which it is placed is 3 feet wide, 3 feet  $3\frac{1}{2}$  inches high, and 20 inches deep.

If the oven had been set in one corner of this Fire-place, instead of occupying the middle of it, near one quarter of the bricks that were used might have been saved; but if in building a new chimney a convenient place were chosen and prepared for it, an oven of this kind might be put up at a very small expence indeed; perhaps for 3s. or 3s. 6d., which would reduce the cost of the oven, when set, to about 7s. or 7s. 6d.

Though the bricklayer was above 3 hours putting up this oven, yet, as it was the first he ever set, there is no doubt but that he was considerably longer in doing the work on that account. He thinks he could put up another in two hours, and I am of the same opinion.

I think it would be adviseable, in order to facilitate stowage and carriage of these small ovens, always to manufacture them in nests of four, one within the other, even when they are designed to be sold, and to be put up singly; for it can be of no great importance whether they be a quarter of an inch or half an inch wider, or narrower; and it will often be a great convenience to be able to pack them one within the other, especially when they are to be sent to any considerable distance.

If



If care be taken in making them, to preserve their forms and dimensions, and if the seams of the metal be properly beaten down, the difference in the sizes of two ovens that will fit one within the other need not be very considerable.—But I forget that I am writing for the cleverest and most experienced workmen upon the face of the earth, to whom the utility of these contrivances is perfectly familiar, and who, without waiting for my suggestions, will not fail to put them all in practice.

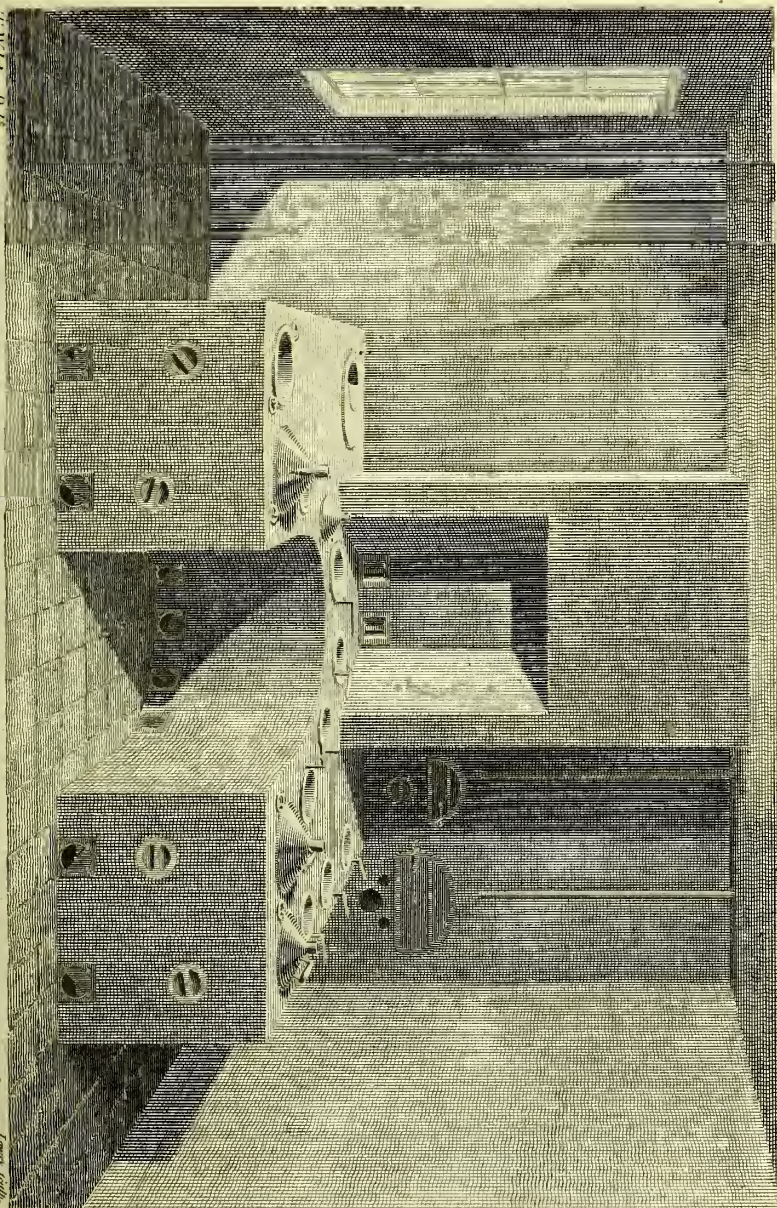
Though there is nothing I am more anxious to avoid than tiring my reader with useless repetitions, yet I cannot help mentioning once more the great importance of causing the smoke that heats one of the ovens I have been describing, to descend at least as low as the level of the bottom of the oven, after it has passed round and over it, before it is permitted to rise up freely and escape by the chimney into the atmosphere. In setting the oven, and forming the canal for carrying off the smoke from the oven into the chimney, this may easily be effected; and if it be done, the oven will retain its heat for a great length of time even after the fire is gone out;—but if it be not done, the fire must constantly be kept up, or the oven will soon be cooled by the cold air that will not fail to force its way through the Fire-place and up the chimney.

From the result of this experiment it appears, that an oven of the kind recommended is very far  
from

from being an expensive article ; and there is no doubt but that, with a little care in the management of the fire, an oven of this sort would last many years without wanting any repairs. It is hardly necessary for me to add, that a nest of these small ovens, consisting of three or four, put up together, and heated by a single fire, would be very useful in the kitchen of a private gentleman, and indeed of every large family.

If nests of small ovens should come into use, (which I cannot help thinking will be the case,) it would be best, as well for convenience in carriage as for other reasons, to make those which belong to the same nest, not precisely of the same dimensions, but varying in size just so much as shall be necessary, in order that they may be packed one within the other.

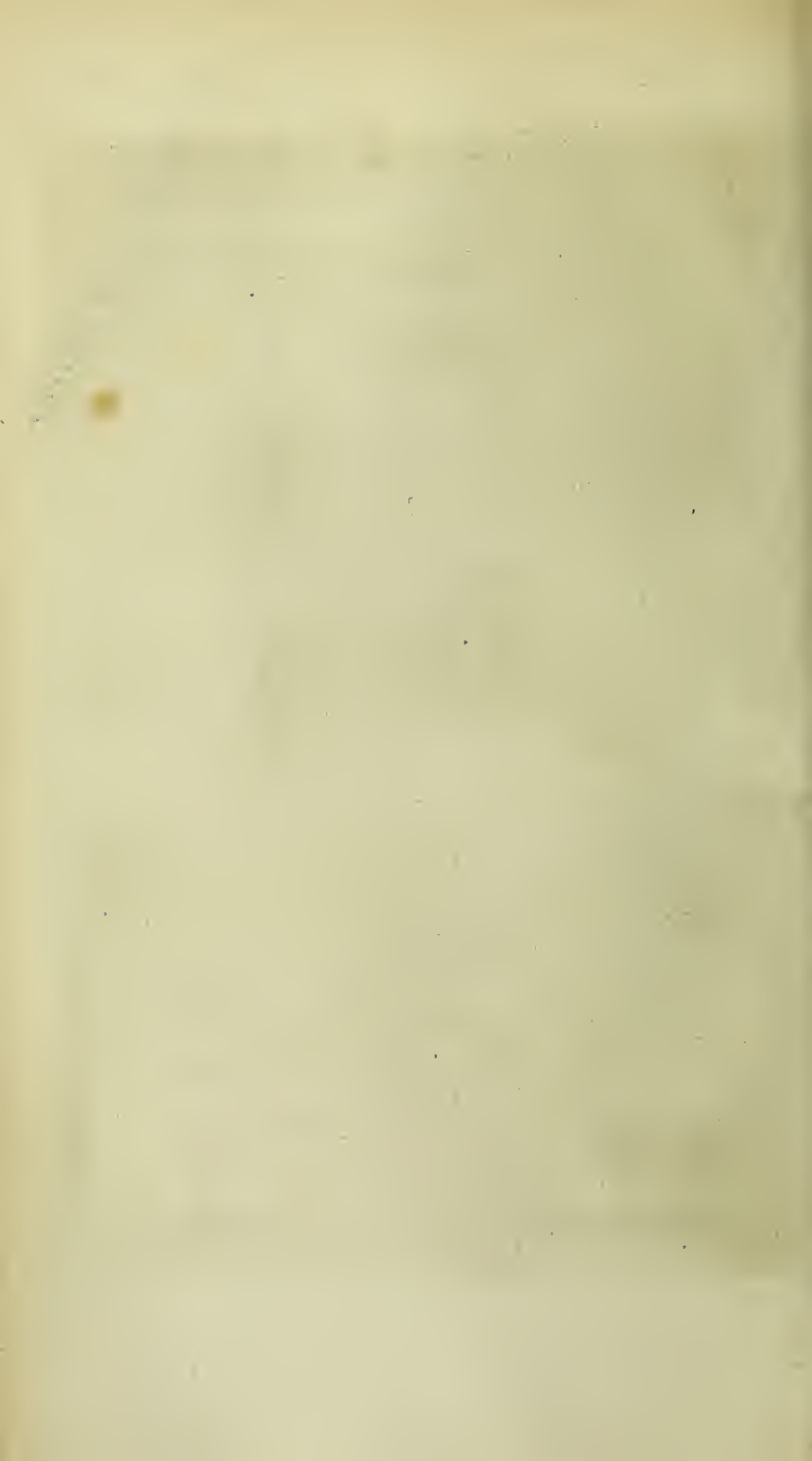




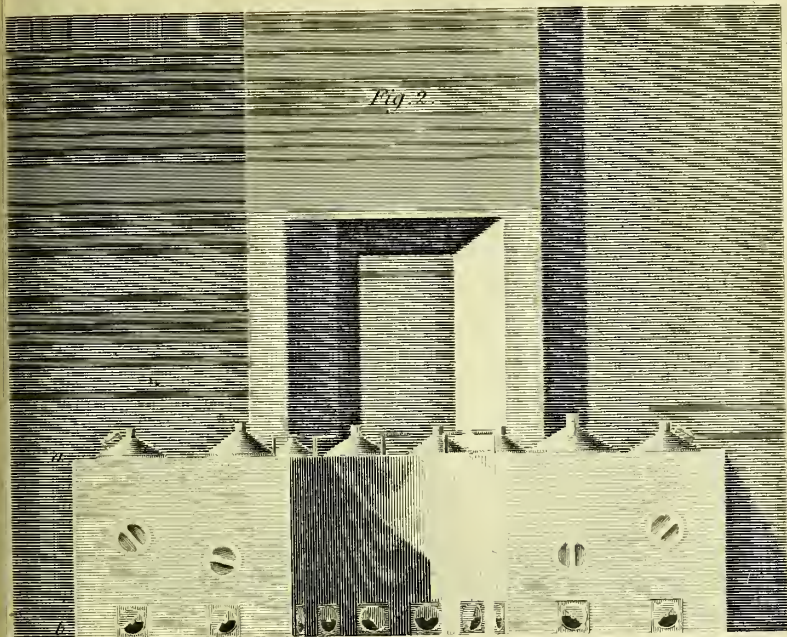
W. Weber del.

L. Meyer sculp.

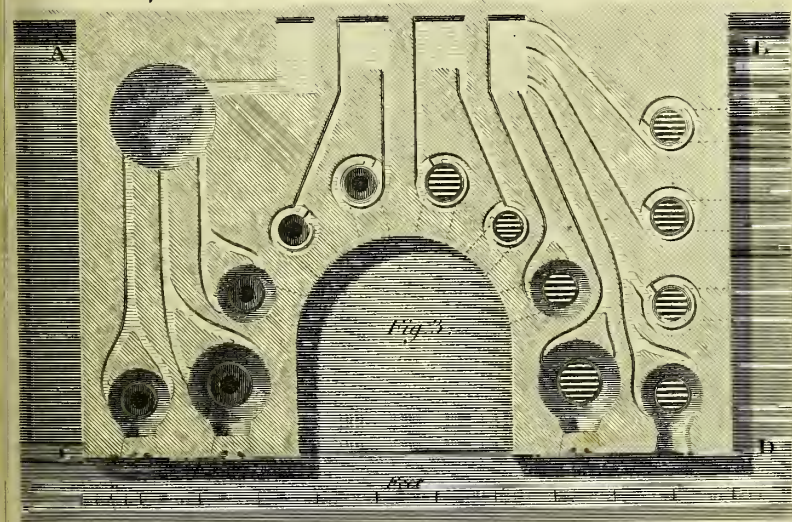
*Perspective View of the Kitchen of Baron de Souchesfeld at Mannheim.*

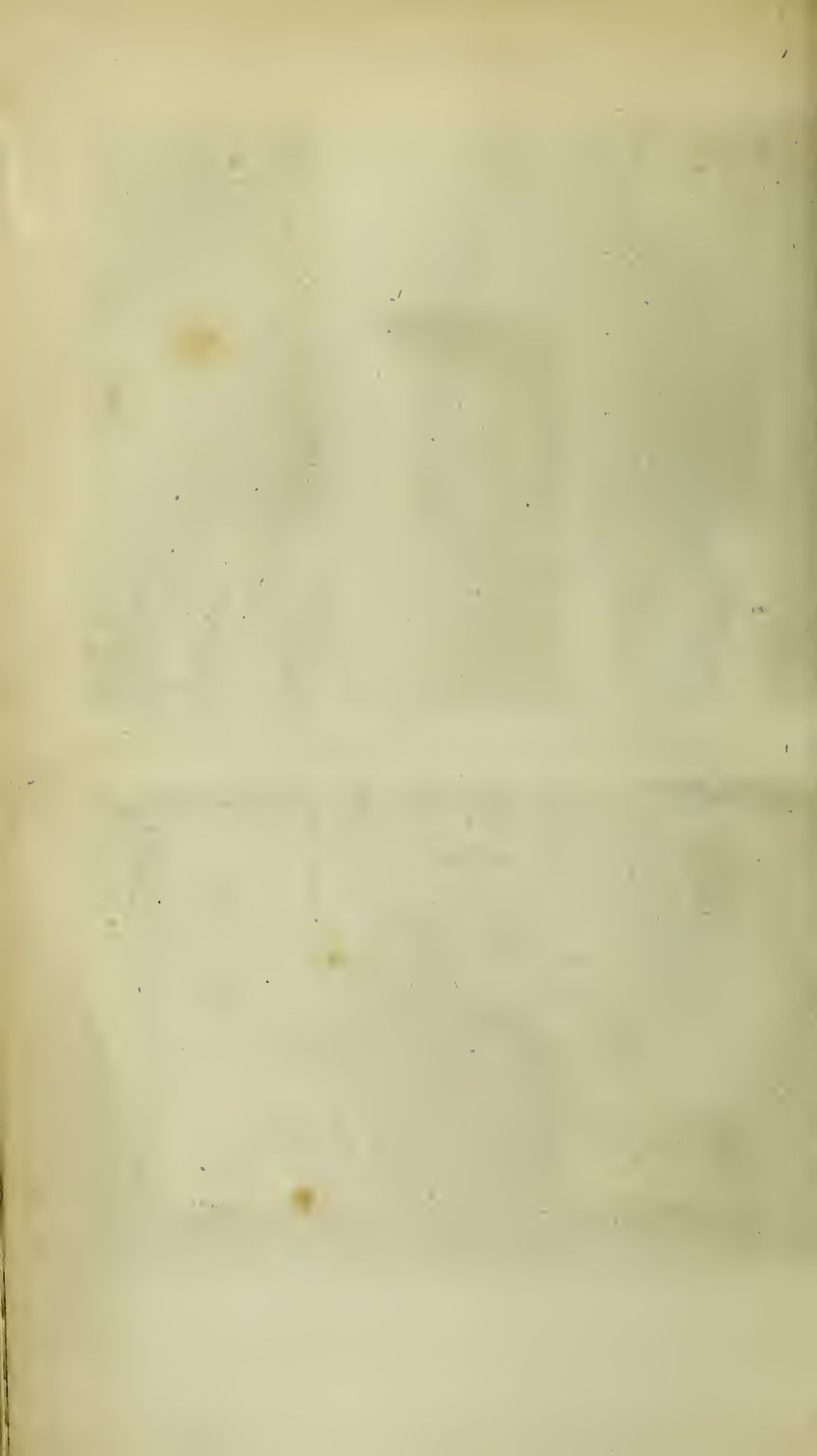




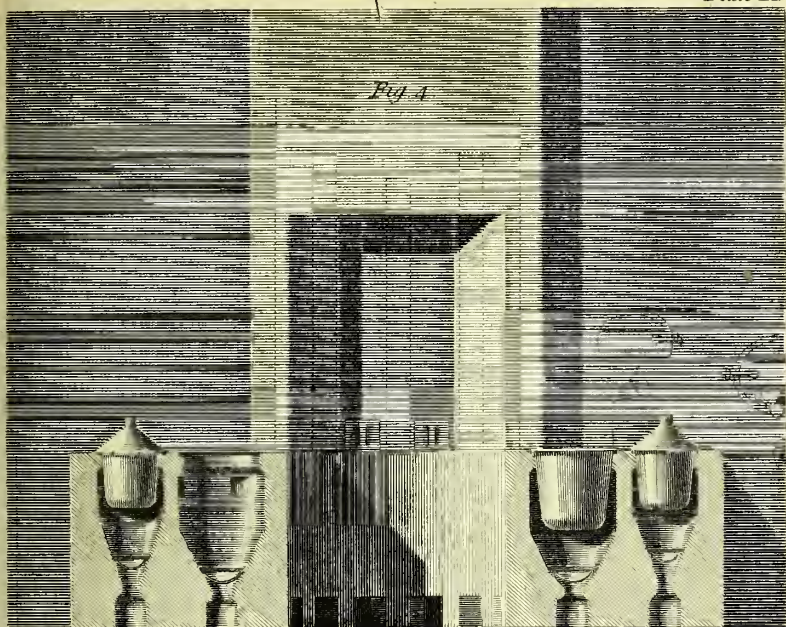


*Plans of Baron de Lerchenfeld's Kitchen?*

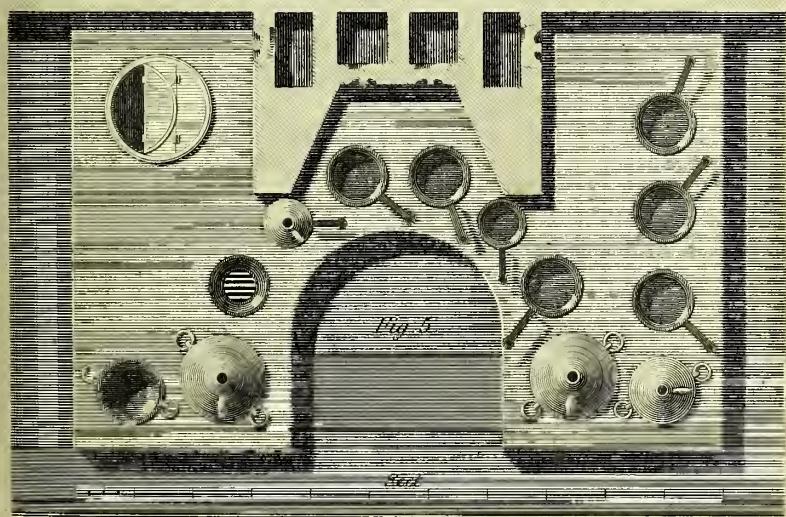








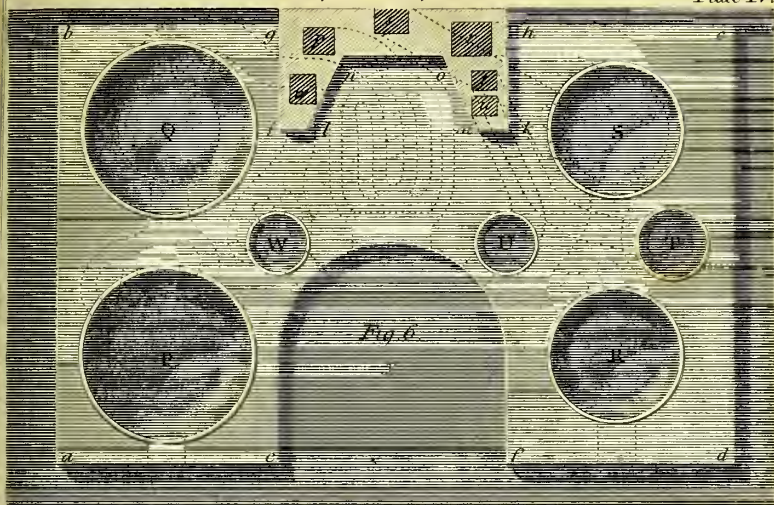
*Plans of Baron de Serchenfelds Kitchen.*



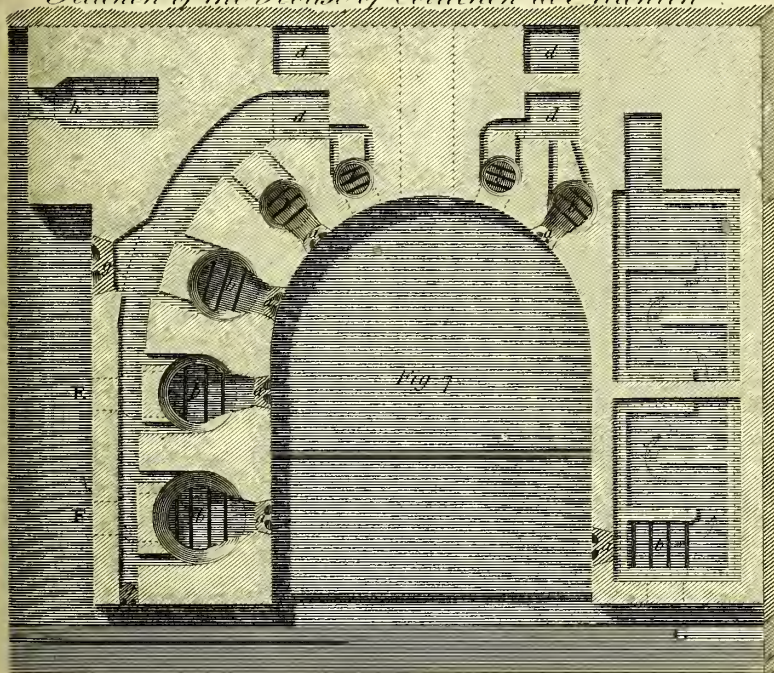


*Kitchen of the Hospital of La Pietà at Verona.*

Plate IV.



*Kitchen of the House of Correction at Munich.*



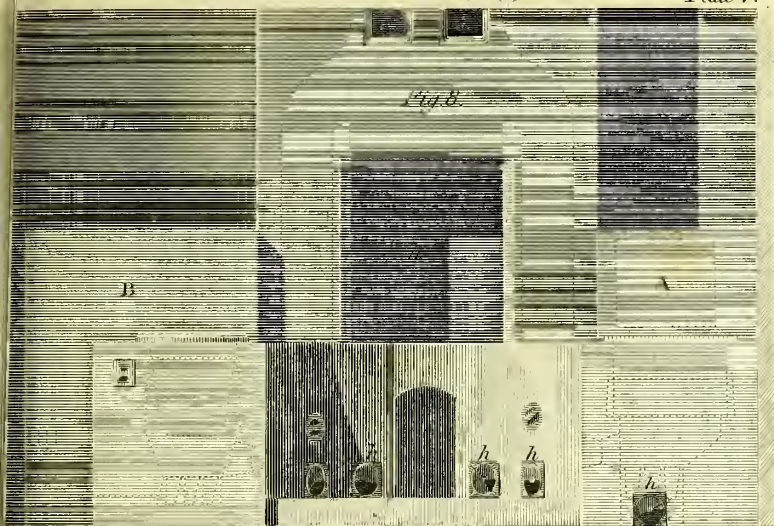
Scale 40 Inches to the Inch .

Lowry sculp.

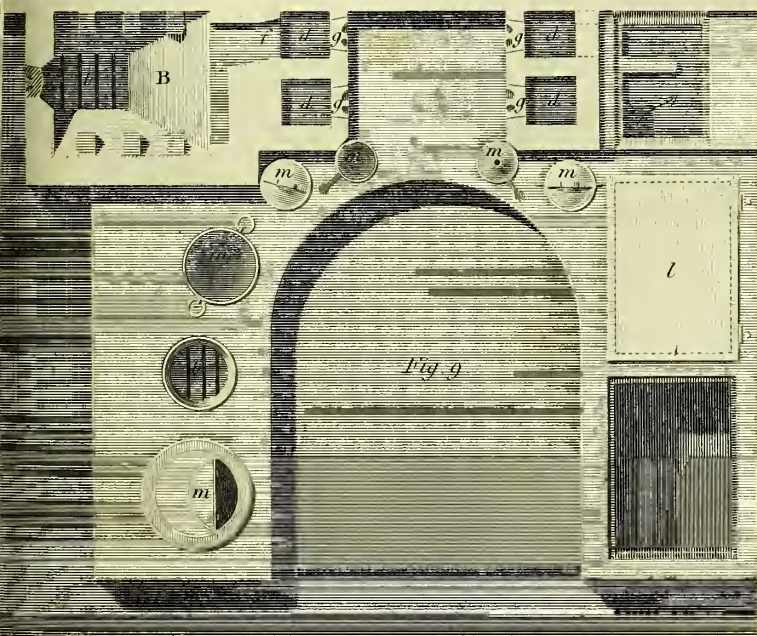




*Front View of the Kitchen of the House of Correction at. Harwich.*  
*Plate V.*



*Birds-eye View*



*Scale 40 Inches to the Inch.*

*Lowry sculp.*

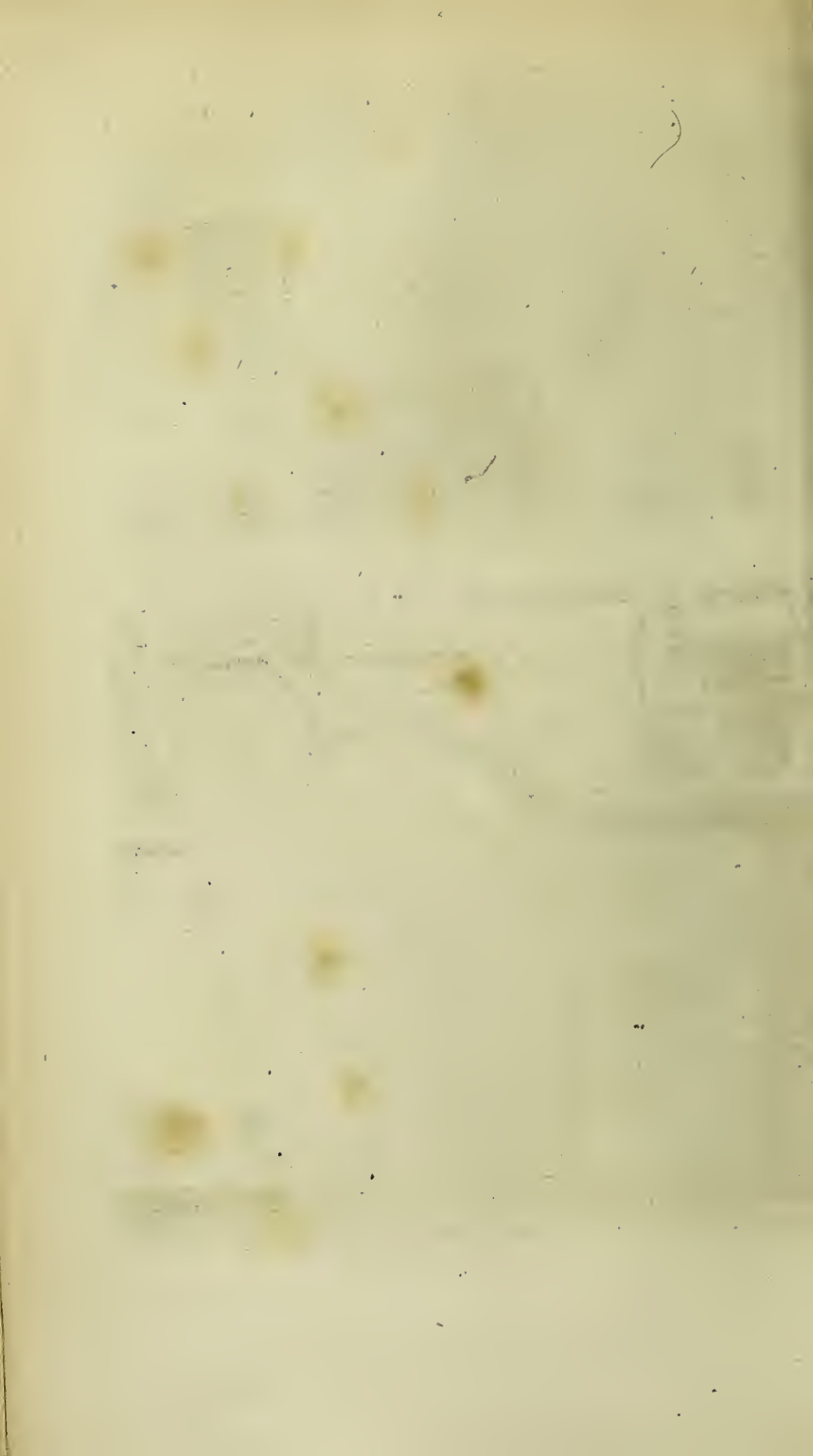




Fig. 11.

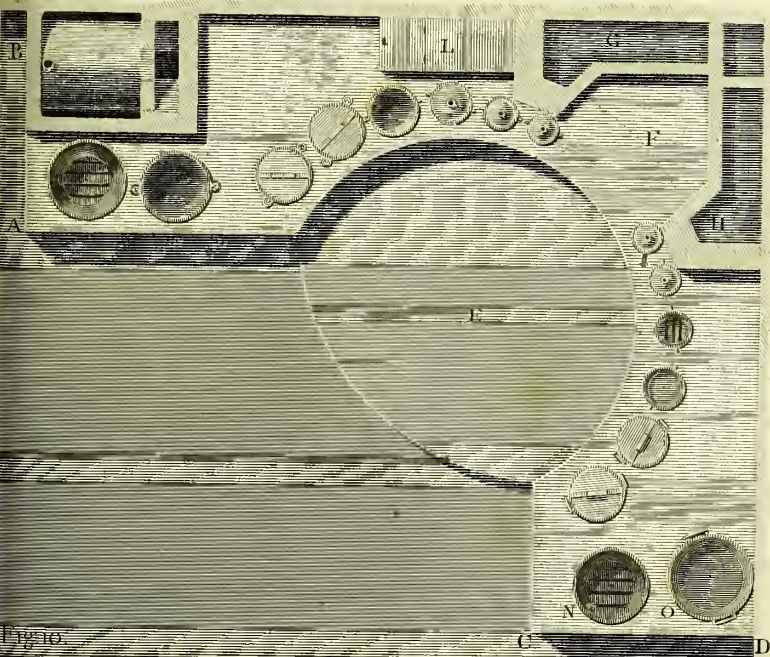
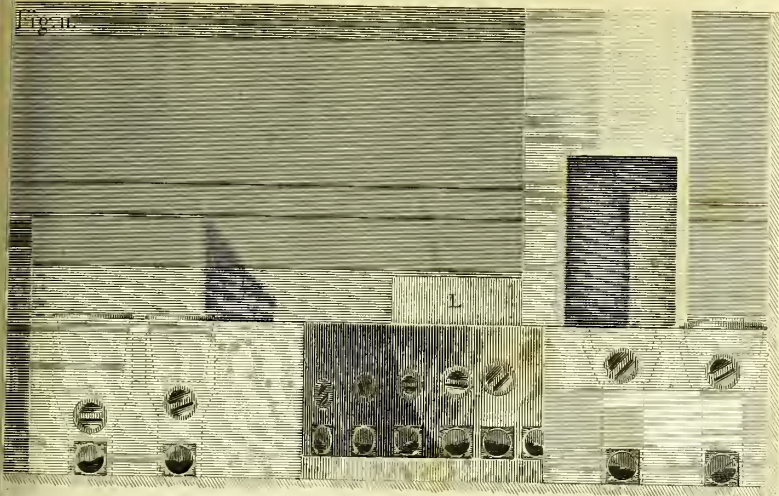
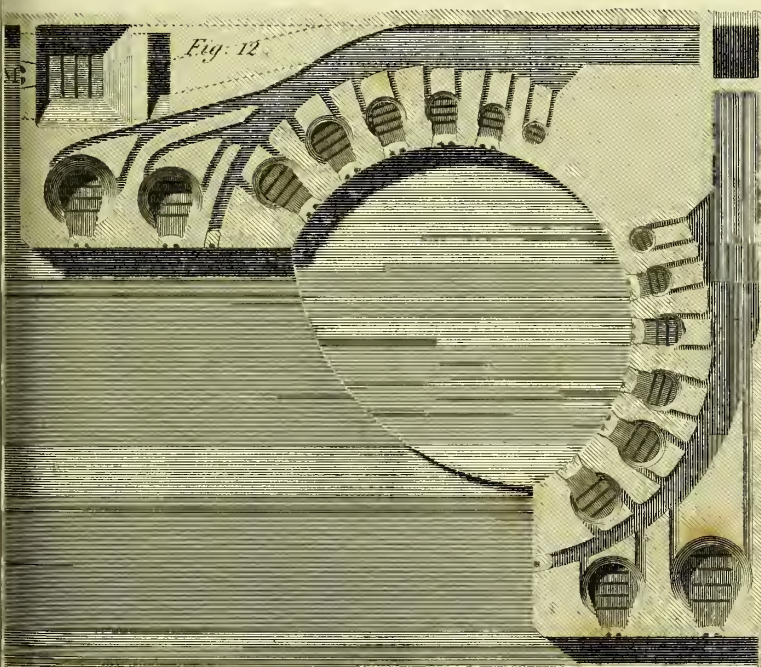
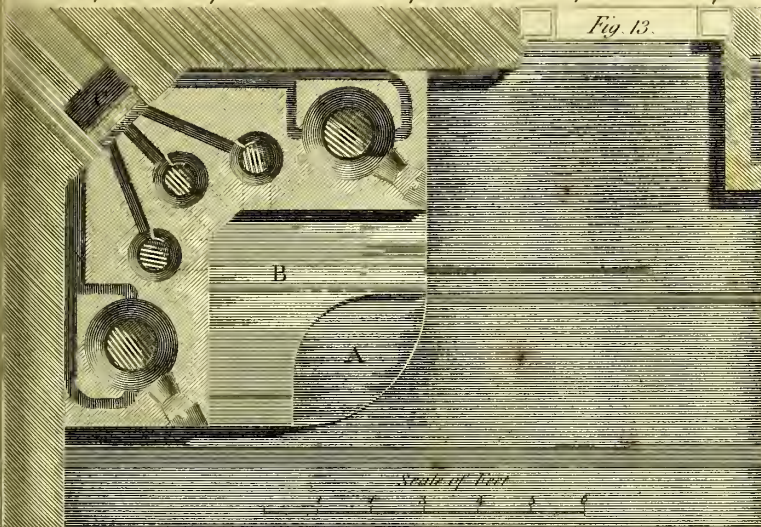


Fig. 10.

Plan & Elevation of the new Kitchen of the Military Hospital  
at Munich.



Fig. 13.







## ESSAY X.

PART II.

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ON THE  
CONSTRUCTION OF KITCHEN FIRE-PLACES  
AND  
KITCHEN UTENSILS;

TOGETHER WITH  
REMARKS AND OBSERVATIONS

RELATING TO THE VARIOUS  
PROCESSES OF COOKERY;

AND  
PROPOSALS FOR IMPROVING  
THAT MOST USEFUL ART.

THE

LIBRARY

OF THE

UNIVERSITY OF

CHICAGO

1887

1887



## P R E F A C E.

I too often find myself in situations, in which I feel it to be necessary to make apologies for delays and irregularities in the publication of my writings. This Second Part of my Tenth Essay was announced in the beginning of the year 1800; and it ought certainly to have made its appearance long ago; but a variety of circumstances have conspired to retard its publication.

During several months, almost the whole of my time was taken up with the business of the ROYAL INSTITUTION; and those who are acquainted with the nature and objects of that noble establishment, will, no doubt, think that I judged wisely, in preferring its interests to every other concern. For my own part, I certainly consider it as being by far the most useful, and consequently the most important undertaking in which I was ever engaged, and of course I feel deeply interested in its success. The distinguished patronage, and liberal support, it has already received, afford good

ground to hope that it will continue to prosper, and be a lasting monument of the liberality and enterprising spirit of an enlightened nation.

It is certainly a proud circumstance for this country, that, in times, like the present, and under the accumulated pressure of a long and expensive war, individuals generously came forward, and subscribed, in a very short time, no less a sum than *thirty thousand pounds sterling*, for the noble purpose of “DIFFUSING THE KNOWLEDGE AND  
“FACILITATING THE GENERAL INTRODUCTION OF NEW AND USEFUL INVENTIONS  
“AND IMPROVEMENTS.”

In the *repository* of this new establishment, will be found, Specimens of all the Mechanical Improvements which I have ventured to recommend to the Public in my Essays.

## ESSAY X.—PART II.

## CHAP. IV.

*An Account of a new Contrivance for roasting meat.—  
 Circumstance which gave rise to this invention.—  
 Means used for introducing it into common use.—  
 List of tradesmen who manufacture Roasters.—Num-  
 ber of them that have already been sold.—Descrip-  
 tion of the Roaster.—Explanation of its action.—  
 Reasons why meat roasted in this machine is better  
 tasted and more wholesome than when roasted on a  
 spit.—It is not only better tasted, but also more  
 in quantity when cooked.—Directions for setting  
 Roasters in brick-work.—Directions for the manage-  
 ment of a Roaster.—Miscellaneous observations re-  
 specting Roasters and ovens.*

**T**HERE is no process of cookery more trouble-  
 some to the cook, or attended with a greater  
 waste of fuel, than roasting meat before an open  
 fire.

Having had occasion, several years ago, to fit up  
 a large kitchen (that belonging to the Military  
 Academy at Munich) in which it was necessary  
 to make arrangements for roasting meat every day  
 for near 200 persons, I was led to consider this  
 subject with some attention; and I availed my-

self of the opportunity which then offered, to make a number of interesting experiments ; from the results of which, I was enabled to construct a machine for Roasting, which upon trial was found to answer so well, that I thought it deserving of being made known to the Public : accordingly, during the visit I made to this country in the years 1795 and 1796, I caused two of these Roasters to be constructed in London—one, at the house then occupied by the BOARD OF AGRICULTURE, and the other, at the FOUNDLING HOSPITAL ; and a third was put up, under my direction, in Dublin, at the house of the DUBLIN SOCIETY.

All these were found to answer very well, and they were often imitated ; but I had the mortification to find, on my return to England in the year 1798, that some mistakes had been made in the construction, and many in the management of them. Their fire-places had almost universally been made three or four times as large as they ought to have been ; as, neither the cooks, nor the bricklayers who were employed in setting them, could be persuaded that it was possible that any thing could be sufficiently roasted with a fire, which to them appeared to be *ridiculously small* ; and the large quantities of fuel which was introduced into these capacious fire-places, not only destroyed the machinery very soon, but, what was still more fatal to the reputation of the contrivance, rendered it impossible for the meat to be well roasted.

When meat, surrounded by air, is exposed to  
the

the action of very intense heat, its surface is soon scorched and dried; which, preventing the meat from penetrating freely to the center of the piece, the meat cannot possibly be equally roasted throughout. *heat*

These mistakes could not fail to discredit the invention, and retard its introduction into general use; but, being convinced, by long experience, of the utility of the contrivance, as well as by the unanimous opinion, in its favour, of all those who had given it a fair trial, I was resolved to persist in my endeavours to make it known, and, if possible, to bring it into use in this country. The Roaster, in the kitchen of the Military Academy at Munich, had been in daily use more than eight years; and many others in imitation of it, which had been put up in private families in Bavaria, and other parts of Germany, and in Switzerland, had been found to answer perfectly well; and as that in the kitchen of the Foundling Hospital, in London, had likewise, during the experience of two years, been found to perform, to the entire satisfaction of those who have the direction of that noble Institution, I was justified in concluding, that, wherever the experiment had failed, it must have been owing to mismanagement. And I was the more anxious to get this contrivance brought into general use, as I was perfectly convinced, that meat roasted by this new process, is not merely as good, but *decidedly better*, that is to say, more delicate, more juicy, more savory, and higher flavoured, than



when roasted in the common way—on a spit, before an open fire.

A real improvement in the art of cookery, which unites the advantage of economy with wholesomeness, and an increase of enjoyment in eating, appeared to me to be very interesting; and I attended to the subject with all that zeal and perseverance which a conviction of its importance naturally inspired.

On my return to this country, in the autumn of the year 1798, one of the first things I undertook in the prosecution of my favourite pursuit, was to engage an ingenious tradesman, who lives in a part of the town which is much frequented (Mr. Summers, ironmonger, of New Bond-street) to put up a Roaster in his own kitchen;—to instruct his cook in the management of it;—to make daily use of it; to shew it in actual use to his customers, and others who might desire to see it; and also to allow other cooks to be present, and assist when meat was roasted in it, in order to their being convinced of its utility, and taught how to manage it. I likewise prevailed on him to engage an intelligent bricklayer in his service, who would submit to be taught to set Roasters properly; and who would follow, *without deviation*, the directions he should receive. All these arrangements were carried into execution in the beginning of the year 1799; and since that time Mr. Summers has sold, and put up, no less than 260 Roasters, all of which have been found to answer perfectly well; and although he  
employs



employs a great many hands in the manufacture of this new article, he is not able to satisfy all the demands of his numerous customers.

Many of these Roasters have been put up in the houses of persons of the highest rank and distinction; others in the kitchens of artificers and tradesmen; and others, again, in schools, taverns, and other houses of public resort; and in all these different situations, the use of them has been found to be economical, and advantageous in all respects.

Several other tradesmen in London have also been engaged in the manufacture of Roasters. Mr. Hopkins, of Greek-street, Soho, ironmonger to the King, made that which is at the Foundling hospital, likewise that which was put up in the house formerly occupied by the Board of Agriculture;—and he informs me, that he has sold above 200 others, which have been put up in the kitchens of various hospitals and private families, in the capital, and in different parts of the country.

Messrs. Moffat and Co. of Great Queen-street, Lincoln's-Inn Fields, and Mr. Feetham, of Oxford-street; as also Mr. Gregory, Mr. Spotswood, Mr. Hanan, and Mr. Briadwood, in Edinburgh; have engaged in the manufacture of them. Other tradesmen, no doubt, with whose names I am not acquainted, have manufactured them; and as there is no difficulty whatever in their construction, and as all persons are at full liberty to manufacture and sell them, I hope soon to see these Roasters become a common article of trade.

I have

I have done all that was in my power to improve and to bring them forward into notice; and all my wishes respecting them will be accomplished, if they should be found to be useful; and if the public is furnished with them at reasonable prices.

Several Roasters, constructed by different workmen, may be seen, some of them set in brick-work, and others not, at the Repository of the Royal Institution.

I have delayed thus long to publish a description of this contrivance, in order that its usefulness might previously be established by experience; and also, that I might be able, with the description, to give notice to the public where the thing described might be seen. I was likewise desirous of being able at the same time, to point out *several places* where the article might be had.

These objects having been fully accomplished, I shall now proceed by giving

*An Account of the ROASTER, and of the Principles on which it is constructed.*

WHEN I first set about to contrive this machine, meditating on the nature of the mechanical and chemical operations that take place in the culinary process in question, it appeared to me that there could not possibly be any thing more necessary to the roasting of meat than *heat*, in certain degrees of intensity, accompanied by certain degrees of *dryness*;

*dryness*; and I thought, if matters could be so arranged, by means of simple mechanical contrivances, that the cook should be enabled, not only to regulate the degrees of heat at pleasure, but also to combine any given degree of *heat* with any degree of *moisture*, or of *dryness* required; this would unquestionably put it in his power to perform every process of *roasting* in the highest possible perfection.

The means I used for attaining these ends, will appear by the following description of the machinery I caused to be constructed for that purpose.

The most essential part of this machinery which I shall call the *body* of the Roaster (see fig. 14.) is an hollow cylinder of sheet-iron, which, for a Roaster of a moderate size, may be made about 18 inches in diameter, and 24 inches long; closed at one end, and set in an horizontal position in a mass of brick-work, in such a manner that the flame of a small fire, which is made in a closed fire-place directly under it, may play all round it, and heat it equally and expeditiously. The open end of this cylinder, which should be even with the front of the brick-work in which it is set, is closed either with a double door of sheet-iron, or with a single door of sheet-iron covered on the outside with a pannel of wood; and in the cylinder there is an horizontal shelf, made of a flat plate of sheet-iron, which is supported on ledges rivetted to the inside of the cylinder, on each side  
of

of it. This shelf is situated about three inches below the center or level of the axis of the body of the Roaster, and it serves as a support for a dripping-pan, in which, or rather *over which* the meat to be roasted is placed.

This dripping-pan, which is made of sheet-iron, is about two inches deep, 16 inches wide above,  $15\frac{1}{4}$  inches in width below, and 22 inches long; and it is placed on four short feet; or what is better, on two long sliders, bent upwards at their two extremities, and fastened to the ends of the dripping-pan, forming, together with the dripping-pan, a kind of sledge; the bottom of the dripping-pan being raised by these means about an inch above the horizontal shelf on which it is supported.

In order that the dripping-pan on being pushed into or drawn out of the Roaster may be made to preserve its direction, two strait grooves are made in the shelf on which it is supported, which, receiving the sliders of the dripping-pan, prevent it from slipping about from side to side, and striking against the sides of the Roaster. The front ends of these grooves are seen in figure 14, as are also the front ends of the sliders of the dripping-pan; and one of its handles.

In the dripping-pan, a gridiron (seen in fig. 14.) is placed, the horizontal bars of which are on a level with the sides or brim of the dripping-pan, and on this gridiron the meat to be roasted is laid; care being taken that there be always a sufficient quantity



quantity of water in the dripping-pan to cover the whole of its bottom to the height of at least half or three quarters of an inch.

This water is essential to the success of the process of roasting: it is designed for receiving the drippings from the meat, and preventing their falling on the heated bottom of the dripping-pan, where they would be evaporated, and their oily parts burnt or volatilized, filling the Roaster with ill-scented vapours which would spoil the meat, by giving it a disagreeable taste and smell.

It was with a view more effectually to defend the bottom of the dripping-pan from the fire, and prevent as much as possible the evaporation of the water it contains, that the dripping-pan was raised on feet or sliders, instead of being merely set down on its bottom on the shelf which supports it in the Roaster.

A late improvement has been made in the arrangement of the dripping-pan, by an ingenious workman at Norwich, Mr. Frost, who has been employed in putting up Roasters in that part of the country; an invention which I think will, in many cases, if not in all, be found very useful. Having put a certain quantity of water into the principal dripping-pan, which is constructed of sheet-iron, he places a second, shallower, made of tin, and standing on four short feet, into the first, and then places the gridiron which is to support the meat in this second dripping pan. As the water in the first keeps the second cool, there is no necessity  
for



for putting water into this; and the drippings of the meat may, without danger, be suffered to fall into it, and to remain there unmixed with water. When Yorkshire puddings, or potatoes, are cooked under roasting meat, this arrangement will be found very convenient.

In constructing the dripping-pans, and fitting them to each other, care must be taken that the second do not touch the first, except by the ends of its feet; and especially that the bottom of the second (which may be made dishing) do not touch the bottom of the first. The lengths and widths of the two dripping-pans above, or at their brims, may be equal, and the brim of the second may stand about half an inch above the level of the brim of the first. The horizontal level of the upper surface of the gridiron should not be lower than the level of the brim of the second dripping-pan; and the meat should be so placed on the gridiron that the drippings from it cannot fail to fall into the dripping-pan, and never upon the hot bottom or sides of the Roaster.

To carry off the steam which arises from the water in the dripping-pan, and that which escapes from the meat in roasting, there is a steam-tube belonging to the Roaster, which is situated at the upper part of the Roaster, commonly a little on one side, and near the front of it, to which tube there is a damper, which is so contrived as to be easily regulated without opening the door of the

Roaster.

**Roaster.** This steam-tube is distinctly seen in figure 14; and the end of the handle by which its damper is moved, may be seen in figure 15.

The heat of the Roaster is regulated at pleasure, and to the greatest nicety, by means of the register in the ash-pit door of its fire-place (represented in figure 15.) and by the damper in the canal, by which the smoke goes off into the chimney; which damper is not represented in any of the figures.

The *dryness* in the Roaster is regulated by the damper of the steam-tube, and also by means of a very essential part of the apparatus—the *blow-pipes*—which still remain to be described. They are distinctly represented in the figures 14, 15, and 16.

These blow-pipes, which lie immediately under the Roaster, are two tubes of iron, about  $2\frac{1}{2}$  inches in diameter, and 23 inches long, or about one inch shorter than the Roaster; which tubes, by means of elbows at their farther ends, are firmly fixed to the bottom of the Roaster, and communicate with the inside of it. The hither ends of these tubes come through the brick-work, and are seen in front of the Roaster, being even with its face.

These blow-pipes have stoppers, by which they are accurately closed; but when the meat is to be *browned*, these stoppers are removed, or drawn out a little, and the damper in the steam-tube of the Roaster being at the same time opened, a strong  
current

current of hot air presses in through the tubes into the Roaster, and through the Roaster into and through the steam-tube, carrying and driving away all the moist air and vapour out of the Roaster.

As these blow-pipes are situated immediately below the Roaster, and just over the fire, and are surrounded on every side by the flame of the burning fuel (see figure 16.) they are much exposed to the heat; and when the fire is made to burn briskly, which should always be done when the meat is to be browned, they will be heated red-hot, consequently the air which passes through them into the Roaster will be much heated; and this *hot wind* which blows over the meat, will suddenly heat and dry its surface in every part, and give it that appearance and taste which are peculiar to meat that is well roasted.

When these Roasters were first proposed, and before their merit was established, many doubts were entertained respecting the taste of the food prepared in them. As the meat was shut up in a confined space, which has much the appearance of an oven, it was natural enough to suspect that it would be rather *baked* than *roasted*; but all those who have tried the experiment have found that this is by no means the case. The meat is *roasted*, and not *baked*; and however bold the assertion may appear, I will venture to affirm, that meat of every kind, without any exception, roasted in a roaster, is *better tasted—higher flavoured—and much*

*more juicy and delicate*, than when roasted on a spit before an open fire.

I should not have dared to have published this opinion four years ago ; but I can with safety do it now, for I can appeal for a confirmation of the fact to the results of a number of decisive experiments, lately made in this metropolis, and by the most *competent judges*.

Among many others who, during the last year, have caused Roasters to be put up in their kitchens, I could mention one person in particular, a nobleman, distinguished as much by his ingenuity and indefatigable zeal in promoting useful improvements, as by his urbanity and his knowledge in the art of refined cookery ; who had *two Roasters* put in his house in town, and who informs me, that he has frequently invited company to dine with him since his Roasters have been in use, and that the dishes prepared in them have never failed to meet with marked approbation.

In enumerating the excellencies of this new implement of cookery, there is one of indisputable importance, which ought not to be omitted. When meat is roasted in this machine, its *quantity*, determined by weight, is considerably greater than if it were roasted upon a spit before a fire. To ascertain this fact, two legs of mutton, taken from the same carcase, and made perfectly equal in weight before they were cooked, were roasted on the same day, the one in a Roaster, the other on a spit before the fire ; and to prevent all deception,



the persons employed in roasting them were not informed of the principal design of the experiment. When these pieces of roasted meat came from the fire, they were carefully weighed; when it appeared, that the piece which had been roasted in the Roaster was heavier than the other, by a difference which was equal to six *per Cent.* or six pounds in an hundred. But this even is not all; nor is it indeed the most important result of the experiment. These two legs of mutton were brought upon table at the same time, and a large and perfectly unprejudiced company was assembled to eat them. They were both declared to be very good; but a decided preference was unanimously given to that which had been roasted in the Roaster, it was much more juicy, and was thought better tasted. They were both fairly eaten up; nothing remaining of either of them that was eatable. Their fragments, which had been carefully preserved, being now collected and placed in their separate dishes; it was *a comparison of these fragments* which afforded the most striking proof of the relative merit of these two methods of roasting meat, in respect to the economy of food. Of the leg of mutton which had been roasted in the Roaster, hardly any thing visible remained except the bare bone; while a considerable heap was formed of scraps not eatable, which remained of that roasted on a spit.

I believe I may venture to say, that the result of this experiment is deserving of the most serious  
attention,



attention, especially in this country, where so much roasted meat is eaten, and where the economy of food is every day growing to be more and more an object of public concern.

I could mention several other experiments similar to that just described, which have been made, and with similar results; but it would be superfluous to bring many examples to ascertain a fact, which is so well established by one.

There is one peculiarity more, respecting meat roasted in a Roaster, which I must mention; that is, the uncommon delicacy of the taste of the fat of the meat so roasted, especially when it has been done by *a very slow fire*. When good mutton is roasted in this manner, its fat is exquisitely sweet and well tasted; and when eaten with currant jelly, can hardly be distinguished from the fat of the very best venison. The fat parts of other kinds of meat are also uncommonly delicate when prepared in this manner; and there is reason to think that they are much less unwholesome than when they are roasted before an open fire.

The heat which is generated by the rays which proceed from burning fuel, is frequently most intense; and hence it is that the surface of a piece of meat that is roasted on a spit, is often quite burnt, and rendered not only hard and ill-tasted, but very unwholesome. The fat of venison is not thought to be unwholesome; but in roasting venison, care is taken by covering it, to prevent the rays from the fire from burning it. In the Roast-

ing machine, the bad effects of these direct rays are always prevented by the sides of the Roaster, which intercepts them, and protects the surface of the meat from the excessive violence of their action ; and even, when at the end of the process of roasting, the intensity of the heat in the Roaster is so far increased as to brown the surface of the meat, yet this heat being communicated through the medium of a heated fluid (air) is much more moderate and uniform and certain in its effects, than direct rays which proceed from burning fuel, or from bodies heated to a state of incandescence.

*Directions for SETTING Roasters.*

THERE are two points, to which attention must be paid by bricklayers in SETTING these Roasters ; otherwise they will not be found to answer. Their fire-places must be made extremely small ; and provision must be made for cleaning out their flues from time to time when they become obstructed with soot.

When I first introduced these Roasters into this country five years ago, I was not fully aware of the irresistible propensity to make too great fires on all occasions, which those people have who inhabit kitchens ; but sad experience has since taught me, that nothing short of rendering it absolutely impossible to destroy my Roasters by fire, will prevent their being so destroyed. The knowledge of this  
fact

fact has put me on my guard, and I now take effectual measures for preventing this evil. I cause the fire-places of Roasters to be made *very small*, and direct them to be situated at a considerable distance below the bottom of the Roaster.

For a Roaster which is 18 inches wide, and 24 inches long, the fire-place should not be more than seven inches wide and nine inches long; and the side walls of the fire-place should be quite vertical to the height of six or seven inches. Small as this fire-place may appear to be, it will contain quite coals enough to heat the Roaster, and many more than will be found necessary for keeping it hot when heated. The fact is, that the quantity of fuel required to roast meat in this way, is almost incredibly small. By experiments, made with great care at the Foundling Hospital, it appeared to be only about *one sixteenth* part of the quantity which would be required to roast the same quantity of meat in the common way before an open fire. But it is not merely to save fuel that I recommend the fire-places to be made very small;—it is to prevent the Roasters from being wantonly destroyed, the meat spoiled, and a useful invention discredited.

With regard to the provision which ought to be made, in the setting of a Roaster, for occasionally cleaning out its flues, this must be done by leaving proper openings (about four or five inches square for instance) in the brick-work, to introduce a brush, like a bottle-brush, with a long handle; which openings may be closed with stoppers or fit

pieces, of brick, or of stone, and the joinings made good with a little moist clay. To render these stoppers more conspicuous, they may each be furnished with a small iron ring or knob, which will likewise be useful as an handle in removing them, and replacing them.

In the figures of 15 and 16, a simple contrivance may be seen, represented, by means of which the soot which is apt to collect about the top of a Roaster, may be removed with very little trouble as often as it shall be found necessary, without injuring the brick-work, or deranging any part of the machinery. By means of an oblong square frame, constructed of sheet iron, and fastened to the top of the Roaster by rivets, a door-way is opened into the void space left for the flame and smoke between the outside of the Roaster, and the hollow arch or vault in which it is placed; and by introducing a brush with a flexible handle through this door-way, the soot adhering to the outside of the top of the Roaster, and to the surface of the brick-work surrounding it, may be detached and made to fall back into the fire-place, from whence it may be removed with a shovel. The sides of the Roaster may be cleaned by introducing a brush through the door-way of the fire-place.

The door-way at the top of the Roaster may be closed either by a stopper made of sheet iron, or by a fit piece of stone or brick, furnished with a ring or knob, to serve as a handle to it.

It coke be burnt under these Roasters, instead  
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of coal (which, as they will not be more expensive fuel, and as they burn longer, and give a more equal heat, I would strongly recommend) the flues will seldom if ever require to be cleaned out. I burn nothing but coke and a few pieces of wood, in the closed fire-places of my own kitchen; and for my open chimney fires, I use a mixture of coke and coals, which makes a very pleasant fire, and is, I believe, less expensive than coals. It appears to me that there is no subject which offers so promising a field for experimental investigation, and where useful improvements would be so likely to be made, as in the *combination and preparation of fuel*.—But to return from this digression.

In constructing the fire-place of a Roaster (and all other closed fire-places) care must be taken to place the iron-bars on which the fuel burns, at a considerable distance from the door of the fire-place; otherwise this door being near the fire, its handle will become very hot, and it will burn the hand of a person that takes hold of it. I have more than once seen Roasters and ovens condemned, disgraced, and totally neglected, merely from an accident of this kind. And yet how easy would it have been to have corrected this fault!—If the door of the fire-place is formed to become too hot, send for the bricklayer, and let him put the fire-place farther backward.

There should always be a passage, or throat, of a certain length, between the mouth or door of a closed fire-place, and the fire-place properly so



called, or the cavity occupied by the burning fuel. Where fire-places are of large dimensions, it is very useful (as indeed it is customary) to keep this throat constantly filled and choaked up with coal. This coal, which, as there is no supply of air in the passage, does not burn, serves to defend the fire-place door from the heat of the fire. It serves another useful purpose; it gets well warmed, and even heated very hot before it is pushed forward into the fire-place, which disposes it to take fire instantaneously, and without cooling the fire-place and depressing the fire when it is introduced. If any part of it takes fire while it occupies the throat or passage of the fire-place, it is that part only which is in immediate contact with the burning fuel; and what is so burnt, is consumed under the most advantageous circumstances; for the thick vapour which rises from this coal, as it grows very hot, and which, under other less favourable circumstances, would not fail to go off in smoke, takes fire in passing over the burning fuel, and burns with a clear bright flame. I have had frequent opportunities of verifying this interesting fact; and I mention it now, in order, if possible, to fix the attention of those who have the management of large fires, to an object which perhaps is of greater importance than they are aware of.

When good reasons can be assigned for the advantages which result from any common practice, this not only tends to satisfy the mind, and make people careful, cheerful, and attentive in the prosecution

secution of their business, but it has also a very salutary influence, by preventing those perpetual variations and idle attempts at improvement, *undirected by science*, which are the consequence of the inconstancy, curiosity, and restlessness of man.

Discoveries are always accidental; and the great use of *science* is by investigating the nature of the effects produced by any process or contrivance, and of the causes by which they are brought about, to explain the operation, and determine the precise value of every new invention. This fixes as it were the *latitude* and *longitude* of each discovery, and enables us to place it in that part of the map of human knowledge which it ought to occupy. It likewise enables us to use it in taking *bearings* and *distances*, and in shaping our course when we go in search of new discoveries.—But I am again straying very far from my humble subject.

In constructing closed fire-places for Roasters, Boilers, Ovens, &c. for kitchens, I have found it to be a good general rule to make the distance between the fire-place door and the hither end of the bars of the grate, just equal to the width of the fire-place, measured just above the bars. In fire-places of a moderate size, where double doors are used, it will suffice, if the distance from the hinder side of the inner door, to the hither end of the bars, be made equal to the width of a brick, or  $4\frac{1}{2}$  inches; but if the door be not double, it is necessary that the length of the passage from the  
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the door, into the place occupied by the burning fuel, should be at least six or seven inches.

In setting the iron frame of the door of a closed fire-place, care should be taken to mask the metal by setting the bricks before it in such a manner that no part of the frame *may be seen* (if I may use that expression) by the fire. This precaution should be used in constructing fire-places of all sizes, otherwise the frame of the fire-place door will be heated very hot by the rays from the burning fuel, especially when the fire-place is large, and its form will soon be destroyed by the frequent expansion and contraction of the metal. The consequences of this change of form will be, the loosening of the frame in the brick-work, and the admission of air into the fire-place over the fire, between the sides of the frame and the brick-work, and likewise between the frame and its door, which will no longer fit each other.

The expence of keeping large fire-places in repair is very considerable, as I have learnt from some of the London brewers. More than *nine-tenths* of that expence might easily be saved, by constructing the machinery more scientifically, and using it with care.

Fig. 15, is a front view ; and fig. 16, represents a vertical section of a Roaster, set in brick-work. The hollow spaces represented in fig. 16. are expressed by strong vertical lines, namely, the ash-pit, A. the fire-place, B. The space between the outside of the Roaster, and the arch of brick-work which

which surrounds it, C.—the broad canal at the farther end of the Roaster, by which the smoke descends, D.—and the place E, where it turns, in order to pass upwards into the chimney by the perpendicular canal, F.—The brick-work is expressed by fainter lines drawn in the same direction.

The farther end of the Roaster must be so fixed in the brick-work, that no part of the smoke can find its way from the fire-place B, directly into the canal D, otherwise it will not pass up by the sides of the Roaster to the top of it. At the top of the Roaster, at its farther end, an opening must of course be left for the smoke to pass into the descending canal D.

As I have already mentioned the necessity of causing the smoke, which is used for heating an iron oven or a Roaster, *to descend* before it is permitted to pass off into the chimney, I shall insist no farther on that important point in this place. It may, however, be useful to observe, that if the place where a Roaster is set is not deep enough to allow of the descending canal, D, and the canal F, by which the smoke ascends and passes into the chimney, to be situated at the farther end of the Roaster, both these canals may, without the smallest inconvenience, be placed on one side of the Roaster: indeed, as houses are now built, it will commonly be most convenient to place them on one side, and not at the end of the Roaster. When this is done, the smoke must be permitted to pass up behind  
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the farther end of the Roaster, as well as by the sides of it.

By taking away a large flat stone, or a twelve-inch tile, placed edgeways, a passage from A to E may be opened occasionally, in order to clean out the canals D and F, and remove the foot. These passages may be cleaned out either from above or from below, by means of a brush, with a long flexible handle.

The steam tube (which is seen in this figure) must open into a separate canal (not expressed in the figure) which must be constructed for the sole purpose of carrying off the steam into the chimney, or into the open air. If this steam tube were to open into either of the cavities or canals C, D, E, or F, in which the smoke from the fire which heats the Roaster circulates, this smoke might, on some occasions, be driven back into the Roaster, which could not fail to give a bad taste to the meat. The steam tube must be laid on a *descent*, otherwise the water generated in it, in consequence of the condensation of the steam, might run back into the Roaster.

Some care will be necessary in forming the vault which is to cover the Roaster above. Its form should be regular, in order that it may be every where at the same distance from the Roaster; and its concave surface should be as even and smooth as possible, in order that there may be the fewer cavities for the lodgment of foot. The distance between the outside of the Roaster and the concave



cave surface of this vault, may be about two inches; and the same distance may be preserved below, between the brick-work and the sides of the Roaster. In the figure 15, the outline of the fire-place and of the cavity in which the Roaster is set, is indicated by a dotted line.

*Directions for the Management of a Roaster.*

CARE must be taken to keep the Roaster very clean, and above all, to prevent the meat from touching the sides of it, and the gravy from being spilt on its bottom. If by any means it becomes greasy in any part that is exposed to the action of the fire, as the metal becomes hot, this grease will be evaporated, as has already been observed, and will fill the Roaster with the most offensive vapour. When grease spots appear, the inside of the Roaster must be washed, first with soap and water, to take away the grease, and then with pure water, to take away the soap, and it must then be wiped with a cloth till it be quite dry.

The fire must be moderate, and time must be allowed for the meat to be roasted *by the most gentle heat*. About one-third more time should in general be employed in roasting meat in a Roaster, than would be necessary to roast it in the usual way, on a spit before a fire.

The blow-pipes should be kept constantly closed from the time the meat goes into the Roaster, till within 12 or 15 minutes of its being sufficiently done

done to be sent to the table, that is to say, till it is fit *to be browned*.

The meat is browned in the following manner : the fire is made to burn bright and clear for a few minutes, till the blow-pipes begin to be red-hot (which may be seen by withdrawing their stoppers for a moment, and looking into them ;) when the damper of the steam-tube of the Roaster being opened, and the stoppers of the blow-pipes drawn out, a certain quantity of air is permitted to pass through the heated blow-pipes, into and through the Roaster.

I say, *a certain quantity* of air is allowed to pass through the blow-pipes into the Roaster. If the steam-tube and the blow-pipes were set *wide open*, it is very possible, that too much might be admitted, and that the inside of the Roaster and its contents might be cooled by it, instead of being raised to a higher temperature. As the velocity with which the cold air of the atmosphere will rush into and through the blow-pipes of a Roaster will depend on a variety of circumstances, and may be very different even in Roasters of the same size and construction, no general rules can be given in browning the meat for the regulation of the stoppers of the blow-pipes, and of the damper in the steam tube ; these must depend on what may be called *the Trim of the Roaster*, which will soon be discovered by the cook.

There is an infallible rule for the regulation of the damper of the steam tube, *during the time the meat is roasting by a gentle heat*. It must then be kept

kept just so much opened, that the steam which arises from the meat, and from the evaporation of the water in the dripping-pan, may not be seen coming out of the Roaster through the crevices of its door ; for if it be more opened, the cold air of the atmosphere will rush into the Roaster through those crevices, and by partially cooling it, will derange the process that is going on ; and if it be less opened, the room will be filled with steam.

In brightening the fire, preparatory to the browning of the meat, the register in the ash-pit door, and the damper in the canal by which the smoke passes off into the chimney, should both be opened, and it may be useful to stir up the fire with a poker, but this would be a very improper time for throwing a quantity of fresh coals into the fire-place, for that would cool the fire-place, and damp the fire for a considerable time. By far the best method of brightening the fire for this purpose, would be to throw a small faggot into the fire, or a little bundle of dry wood of any kind, split into small pieces about six or seven inches in length. This would afford a clear bright flame, which would heat the blow-pipes quickly, and without injuring them. Indeed wood ought always to be used for heating Roasters, in preference to coal, where it can be had, and the quantity of it required is so extremely small, that the difference in the expence would be very trifling, even here in London, where the price of fire-wood is so high. And if the durability of the machinery be taken

taken into the account, which is but just, I am confident, that for heating Roasters and Ovens constructed of sheet iron, coals would turn out to be dearer fuel than wood.

I have already insisted so much on the necessity of keeping a quantity of water under meat that is roasting, in order to prevent the drippings from the meat from falling on any very hot metal, that I shall not now enlarge farther on the subject, except by saying, once more, that it is a circumstance, to which it is indispensably necessary to pay attention.

When meat is roasted by a very moderate heat, it will seldom or never require being either turned or basted, but when the heat in the Roaster is more intense, it will be found useful both to turn it, and to baste it three or four times during the process. The reason of this difference in the manner of proceeding, will be evident to those who consider the matter with attention.

When Roasters are constructed of large dimensions, several kinds of meat may be roasted in them at the same time. If care be taken to preserve their drippings separate, which may easily be done by placing under each a separate dish, or dripping-pan, standing in water contained in a larger dripping-pan, there will be no mixture of tastes; and, what no doubt will appear still more extraordinary, a whole dinner, consisting of various dishes, roasted, stewed, baked, and boiled, may be prepared at the same time in the same Roaster, with-

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out any mixture whatever of tastes. A respectable friend of mine, who first made the experiment, and who has since repeated it several times, has assured me of this curious fact. It may perhaps, in time, turn out to be an important discovery. A simple and economical contrivance, by means of which all the different processes of cookery could be carried on at the same time, and by one small fire, would, no doubt, be a valuable acquisition.

It is very certain that Roasters will either bake or roast, separately, in the highest possible perfection; and it is not improbable that, with certain precautions in the management of them, they may be made to perform those two processes at the same time, in such a manner as to give general satisfaction. When Roasters are designed for roasting and baking at the same time, they should be made sufficiently large to admit of a shelf above the meat, on which the things to be baked should be placed. I am told, that above half the Roasters lately put up in London, are so constructed, and that they are frequently made to roast and bake at the same time. I shall take another opportunity of enlarging on the utility of this contrivance.

There is a precaution to be taken in opening the door of a Roaster, when meat is roasting in it, which ought never to be neglected; that is, to open the steam-tube and both the blow-pipes, for about a quarter of a minute, or while a person can count fifteen or twenty, before the door of the Roaster be thrown open. This will drive away the



steam and vapour out of the Roaster, which otherwise would not fail to come into the room as often as the door of the Roaster is opened.

As it will frequently happen that the meat will be done before it will be time to send it up to table; when this is the case, it may either be taken out of the Roaster and put into a hot closet, which may very conveniently be situated immediately over the Roaster, or it may remain in the Roaster till it is wanted. If this last mentioned method of keeping it warm be adopted, the following precautions will be necessary for cooling the Roaster, otherwise the process of roasting will still go on, and the meat, instead of being merely kept warm, will be over done: The register in the ash-pit door should be closed; the fire-place door, and the damper in the chimney, should be set wide open; the fire should either be taken out of the fire-place, or it should be covered with cold ashes; and lastly, the damper in the steam-tube and both the blow-pipes should be opened. By these means the heat will very soon be driven away up the chimney, and as soon as it is so far moderated as to be no longer dangerous, the blow-pipes and the damper in the steam-tube may be nearly closed; and if there should be danger of the cooling being carried too far, the fire-place door may be shut. By these means the heat of the Roaster, and of the brick-work which surrounds it, may be moderated and regulated at pleasure, and meat already roasted may be kept warm, for almost any length of time, without any danger of its being spoiled.

*Miscellaneous Observations respecting Roasters and Ovens.*

I SHALL, no doubt, be criticised by many, for dwelling so long on a subject, which to them will appear low, vulgar, and trifling; but I must not be deterred by fastidious criticisms from doing all I can do, to succeed in what I have undertaken. Were I to treat my subject superficially, my writings would be of no use to any body, and my labour would be lost; but by investigating it thoroughly, I may perhaps engage others to pay that attention to it, which, from its importance to society, it certainly deserves. If improvements in articles of elegant luxury, which not one person in ten thousand is rich enough to purchase, are considered as matters of public concern, how much more interesting to a benevolent mind must those improvements be, which contribute to the comfort and convenience of every class of society, rich and poor.

But the subject now under consideration is very far from being uninteresting, even if we consider it merely as it is connected with *science*, without any immediate view to its utility; for in it are involved several of the most abstruse questions relative to the doctrine of heat.

Many have objected to the Roaster, on a supposition that meat cooked in it must necessarily partake more of the nature of *baked* meat than of

*roasted* meat. The general appearance of the machinery is certainly calculated to give rise to that idea, and when it is known that all kinds of baking may be performed in great perfection in the Roaster, that circumstance no doubt tended very much to confirm the suspicion: but when we examine the matter attentively, I think we shall find that this objection is not well founded.

When any thing is baked in an oven, (on the common construction) the heat is gradually *diminishing* during the whole time the process is going on.—In the Roaster, the heat is regulated at pleasure, and can be suddenly increased towards the end of the process; by which means the distinguishing and most delicate operation, *the browning of the surface* of the meat, can be effected in a few minutes, which prevents the drying up of the meat, and the loss of its best juices.

In an oven, the exhalations being confined, the meat seldom fails to acquire a peculiar and very disagreeable smell and taste, which, no doubt, is occasioned solely by those confined vapours. The steam tube of a Roaster being always set open, when, in browning the meat, the heat is sufficiently raised to evaporate the oily particles at its surface, the noxious vapours unavoidably generated in that process are immediately driven away out of the Roaster, by the current of hot and pure air from the blow-pipes. This leaves the meat perfectly free, both from the taste and the smell peculiar to baked meat.

Some

Some have objected to Roasters, on an idea that as the water which is placed under the meat, is (in part at least) evaporated during the process, this must make the meat *sodden*, or give it the appearance and taste of meat boiled in steam; but this objection has no better foundation, than that we have just examined. As steam is much lighter than air, that generated from the water in the dripping-pan, will immediately rise up to the top of the Roaster, and pass off by the steam-tube, and the meat will remain surrounded by air, and not by steam. But were the Roaster to be constantly full of steam, to the perfect exclusion of all air, which however is impossible, this would have no tendency whatever to make the meat *sodden*. It is a curious fact, that steam, so far from being a moist fluid, is perfectly *dry*, as long as it retains its elastic form; and that it is of so drying a nature, that it cannot be contained in wooden vessels, (however well seasoned they may be) without drying them and making them shrink till they crack and fall to pieces.

Steam is never moist. When it is condensed with cold it becomes *water*, which is moisture itself; but the steam in a Roaster, which surrounds meat that is roasting, cannot be condensed upon it; for the surface of the meat, being heated by the caloric rays from the top and sides of the Roaster, is even hotter than the steam.

If steam were a moist fluid, it would be found



very difficult to bake bread, or any thing else, in a common oven.

Meat which is *boiled* or *sodden* in steam, is put cold into the containing vessel, and the hot steam which is admitted, is instantly condensed on its surface, and the water resulting from this condensation of steam, dilutes the juices of the meat, and washes them away, leaving the meat tasteless and insipid at its surface: but when meat is put cold into a Roaster, the water in the dripping-pan being cold likewise, long before it can acquire heat sufficient to make it boil, the surface of the meat will become too hot for steam to be condensed upon it; and were it not to be browned at all, it could not possibly taste *sodden*.

It appears to me, that these illucidations are sufficient to remove the two objections which are most commonly made to the Roaster, by those who are not well acquainted with its mechanism, and manner of acting.

In my account of the blow-pipes, I have said that the current of air which comes into the Roaster through them, when they are opened to brown the meat, "drives away all the moist air and vapour" out of the Roaster." This I well know is not an accurate account of what really happens; but it may serve, perhaps better than a more scientific explanation, to give the generality of readers distinct ideas of the nature of the effects that are produced by them. The noxious vapour generated  
from



from the oily particles that are evaporated by the strong heat, are most certainly driven away, precisely in the manner described; and we have just seen how very essential it is that these vapours should not be permitted to remain in the Roaster;—and whether the surface of the meat be in fact dried by the immediate contact of a current of hot and dry air, or whether this effect is produced in consequence of an increase of calorific rays from the top and sides of the Roaster, occasioned by the additional heat communicated to the internal surface of the Roaster by this hot wind, the utility of the blow-pipes is equally evident in both cases.

## CHAPTER V.

*More particular descriptions of the several parts of the Roaster, designed for the information of workmen—Of the body of the Roaster—Of the advantages which result from its peculiar form—Of the best method of proceeding in covering the iron doors of Roasters, and Ovens, with pannels of wood, for confining the heat—Method of constructing double doors of sheet iron, and of cast iron—Of the blow-pipes—Of the steam tube—Of the dripping-pan—Precautions to be used for preventing the too rapid evaporation of the water in the dripping-pan—Of large Roasters that may be used for roasting and baking at the same time—Precautions which become necessary when Roasters are made very large—Of various alterations that may be made in the forms of Roasters, and of the advantages and disadvantages of each of them—Account of some attempts to simplify the construction of Roasters—Of a Roasting-oven—Of the difference between a Roasting-oven, and a Roaster.*

**A**LTHOUGH it will be easy for persons acquainted with the mechanic arts, and accustomed to examine drawings and descriptions of machines, to form a perfect idea of the invention in question, from what has already been said, yet something more will be necessary for the instruction of artificers, who may be employed in execut-  
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ing the work, and more especially for such as may from these descriptions undertake to construct Roasters, without ever having seen one. By going into these details, I shall no doubt find opportunities for introducing occasional remarks on the uses and management of the various parts of the machinery; which will tend not a little to illustrate the foregoing descriptions, and enable the reader to form a more precise and satisfactory opinion respecting the merit of the contrivance.

*Of the BODY of the Roaster.*

Although I have directed the Body of the Roaster to be made cylindrical, it may, without any considerable inconvenience, be constructed of other forms. The reasons why I preferred the cylindrical form to all others, were, because I was told by workmen, that it was the form of easiest construction; and because I knew it to be the form best adapted for strength and durability.

There is another reason, which I did not dare to communicate to the workmen (iron-plate workers) whom I was obliged to employ, in order to introduce this contrivance into common use in this country: when Roasters are of this form, it will be easy to make them of *cast-iron*, which will render the article not only cheaper to the purchaser, but also much more durable, and better on many accounts.

As

As there is a certain proportion of sulphur in the coal commonly used in this country, I was always perfectly aware of the consequences of burning it *under* Roasters constructed of sheet-iron. I knew that the sulphureous vapour from such fuel would be much more injurious to the Roaster, and especially to its blow-pipes (which are much exposed) than the clear flame of a wood fire; but I trusted to the remedy, which I knew might easily be provided for this defect. I thought that *cast-iron*, which is much less liable to be injured by a coal fire, than wrought iron, would soon be substituted in lieu of it, first for the blow-pipes, and then for the body of the Roaster. In this expectation I have not been disappointed, for the blow-pipes of Roasters are now commonly made of cast-iron by the London workmen; and where sea-coal is used as fuel, they never should be made of any other material.

The first Roasters I caused to be made, had all flat bottoms, and their sides were vertical, and their tops were arched over in the form of a trunk; but several inconveniencies were found to result from this shape. Their bottoms were too much exposed to the heat, and this excessive heat in that part heated the bottom of the dripping-pan too much, and caused the water in it to be soon evaporated; it likewise caused them to warp, and sometimes prevented their doors from closing them with that precision which is necessary.

If the hot air in a Roaster be permitted to escape  
by



by the crevices of its door, or what is still worse and more likely to happen, if cold air be permitted to enter the Roaster by those openings, it is quite impossible that the process of roasting can go on well.

As cold air will always tend to press into the body of the Roaster by every passage that is left open, whenever, the Roaster being hot, the damper of its steam-tube is open; this shows how necessary it is, in roasting meat, not to leave that damper open at any time when it ought to be kept closed.

As iron doors, for confining heat, are very liable to be warped by the expansion of the metal, they should never be made to shut into grooves, but they should be made to close tight by causing the flat surface of the inside of the door to lie against, and touch in all parts, the front edge of the door frame; which front edge must of course be made to be perfectly level, and as smooth as possible.

When the body of the Roaster is made cylindrical, it will be easier to make the front of it, against which its door closes, level, than if it were of any other form; and when the door is circular, by making it a little dishing, it will not be liable to be warped; especially when it is made double.

If the front end of the cylinder of sheet-iron which forms the body of the Roaster, be turned outwards over a very stout iron wire, (about one-third of an inch in diameter for instance,) this will strengthen the Roaster very much, and will render it easier to make the end of the Roaster level, to



receive the flat surface of its door : it can most easily be made level by placing the cylinder in a vertical or upright position, with its open end downwards, on a flat anvil, and hammering the wire above mentioned, till its front edge, which reposes on the anvil, is quite level.

In order that the door of the Roaster may close well, its hinges should be made to project outwards two or three inches beyond the sides of the Roaster ; and it should be fastened, not by a common latch, but by two turn-buckles, situated just opposite to the two hinges. The distance at which the two hinges (and consequently the two turn-buckles) should be placed from each other, should be equal to half the diameter of the Roaster.

The hooks for the hinges, and also the support for the turn-buckles, should be situated at the projecting ends of strong iron straps, fastened at one of their ends to the outside of the Roaster, by means of rivetting-nails. The manner in which these turn-buckles are constructed, and the manner in which they are fastened to the Roaster, may be seen by examining figure 17, where they are represented on a large scale.

The first Roasters that were made were furnished with two separate doors, the one placed about four inches within the body of the Roaster, the other even with its front. As the inside door had no hinges, but, like a common oven door, was taken quite away when the Roaster was opened ; there was some trouble in the management of it ; and it was found that the cooks, to avoid that  
trouble,

trouble, frequently threw it away, and used the roaster without it. This contrivance of the cooks to save trouble, came very near to discredit the Roasters altogether, and to put a final stop to their introduction in this country. The circumstance upon which the principal merit of the Roaster depends, and on which the excellence of the food cooked in it depends entirely, is the *equality of the heat*. When the heat is equal on every side, it may be more *moderate* than when it is unequal; and the more moderate and equal the heat is by which meat can be properly roasted, the better tasted and more wholesome will it be. Now it is quite impossible to keep up an *equal* heat in a Roaster which is closed only by a single door of sheet-iron; for so much heat will pass off *through* such a thin metallic door, and be carried away by the cold air of the atmosphere which is lying against the outside of it, that the degrees of heat in different parts of the Roaster must necessarily be very different; and the consequence of this inequality will be, either that the meat will not be sufficiently done in some parts, or that the heat must be so much increased as to prevent its being well done in any part.

In order to induce persons to be careful in the management of machinery of any kind which is new to them, it is necessary to point out the bad consequences which will result from such neglects and inattentions as they are most liable to fall into in the use of it; for, however particular instructions may be, strict attention to them cannot be

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expected from those who are not aware of the bad effects that may result, from what may appear to them very trifling deviations or neglects.

Those who make Roasters must take the greatest care to construct them in such a manner that they may be accurately closed, and that the heat may not be able to make its way *through* their doors;—and those who use them, must be careful to manage them properly.

There are two ways in which the door of a Roaster may be constructed, so as to confine the heat perfectly well, without giving any additional trouble to the cook in the management of it. It may be made of a single sheet of iron, and covered on the outside with a pannel of wood:—or it may be constructed of two sheets of iron, placed parallel to each other, at the distance of about an inch, and so fastened together that the air between them may be confined.

When a door of single sheet iron is made to confine the heat by means of an outside covering of wood, care must be taken to make such outside wooden covering in the form of a *pannel*, otherwise it will not answer. If a *board* be used instead of a framed pannel it will most certainly warp with the heat, and will either detach itself from the iron door to which it is fastened, or will cause the door to bend, and prevent its closing the Roaster with sufficient accuracy. I have seen several attempts made to use boards, instead of pannels, in covering the outsides of the iron doors of Roasters, and iron ovens; but they were all unsuccessful. It is quite impossible

impossible that they ever should answer, as will be evident to those who will take the trouble to consider the matter with attention.

As Doors of sheet iron, covered with wood on the outside, when they are properly constructed, are admirably calculated for confining heat; I think it worth while to give a detailed account of the precautions that are necessary in the construction of them.

*Of the best Method of covering the Iron Doors of Roasters and Ovens, &c. with Wooden Pannels, for confining the Heat.*

THE object principally to be attended to in this business, is to contrive matters so that the shrinking and swelling of the wood by alternate heat and moisture, shall have no tendency either to detach the wood from the iron-door, or to change its form; or to cause openings in the wood by which the air confined between the wood and the iron can make its escape.

The manner in which this may, in all cases, be done, will be evident from an examination of the figure 18, which represents a front view of the door of a cylindrical Roaster, 18 inches in diameter, covered with a square wooden pannel.

It will be observed, that this pannel consists of square frame tenanted, and fastened together at each of its four corners with a single pin; and filled up in the middle with a square board or pannel, which is confined in its place, by being made to enter  
into



into deep grooves or channels, made to receive it, in the insides of the pieces which form the frame. The circular iron door to which this pannel is fixed, cannot be seen in the figure, being covered and concealed from view by the wood, but its size and position are marked out by a dotted circle; and the heads of ten rivets are seen, by which the wooden pannel is fastened to the iron door. These rivets are made to hold the wood fast to the iron by means of small circular plates of sheet iron, which are distinctly represented in the figure\*.

If the positions of the pins by which the wooden frame is fastened together, and of the rivets which fasten the pannel to the iron door, are considered, it will be evident, that all bad effects of the shrinking of the wood by the heat are prevented by the proposed construction. The four pieces of wood, which constitute the frame of the pannel (which may be of common deal, and about four inches wide, and one inch thick), being fastened with one pin only at each of their joinings at the corners, and these pins being situated in the center of those joinings, if upon the frame, in the middle of each of the four pieces which compose it, a square be drawn in such a manner that the corners of this square may coincide with the centers of the four

\* Instead of these rivets, short wood screws may be used for fastening the wooden pannel to the iron door; but care must be taken to place these screws in the same places which are pointed out for the rivets. The heads of the wood screws must of course be on the inside of the iron door.



pins which hold the frame together, as neither heat nor dryness makes any considerable alteration in the length of the fibres of wood, it is evident that the shrinking of the four pieces which compose this frame, cannot alter the dimensions of this square, or in any way change its position. If, therefore, care be taken in fastening the pannel to the iron door to place the rivetting-nails *in the lines which form the four sides of this square*, the shrinking of the wood will occasion no strain on the iron door, nor have any tendency whatever to change its form; and with regard to the center piece of the pannel, if it be fastened to the iron door by two rivets, situated *in the direction of the fibres of the wood*, in a line dividing this piece into two equal parts, its shrinking will be attended with no kind of inconvenience. Care should however be taken to make this pannel enter so deeply into the grooves in its frame, that when it has shrunk as much as possible, its width shall not be so much reduced as to cause it to come quite out of the grooves. This piece may be made about one-third of an inch thick; and the grooves which receive it may be made of the same width, and about three quarters of an inch deep.

When wooden covers of this kind are made for iron doors of large dimensions, they should be divided into a number of compartments, otherwise the center pieces, or the pannels, properly so called, being very large, the shrinking of the wood

with heat will be apt to make them quit the grooves of their frames, which would open a passage for the cold air to approach the surface of the iron door.

In fastening the wooden pannel to its iron door, it will be best that the wood should not come into immediate contact with the iron. Two or three sheets of cartridge paper placed one upon the other, may be interposed between them; and to prevent the possibility of this paper taking fire, it may previously be rendered incombustible by soaking it in a strong solution of alum, mixed with a little armenian bole, or common clay. This paper will not only assist very much in confining the heat, but will also effectually prevent the wood from being set on fire by heat communicated through the iron door of the Roaster. It is indeed highly improbable that the Roaster should ever be so intensely heated as to produce this effect; but as the strangest accidents sometimes do happen; it is always wise to be prepared for the worst that can happen.

As the center piece of wood, or pannel properly so called, which fills up the wooden frame, is only one-third of an inch in thickness, while the frame is one inch in thickness, it is evident that if the face of the frame be made to apply every where to the flat surface of the iron door, the center piece will not touch it. This circumstance will be rather advantageous than otherwise, in confining the heat; but still it will require some attention in fastening the wood to the iron. Each  
of

of the two rivets which pass through this center piece, must also be made to pass through a small block of wood, about an inch square for instance, and one-third of an inch thick, which will give these rivets a proper bearing, without any strain on the iron door which can tend to alter its form.

When the wood and the iron are firmly rivetted together, the superfluous paper may be taken away with a knife.

The hinges of the door, which in the figure 18 are seen projecting outwards on the right hand, are to be rivetted to the outside surface of the circular iron door; and in order that they may not prevent the pannel from applying properly to the door, they are to be let into the wood. The turn-buckles, by which the door is fastened, must be made to press against the outside or front of the wooden frame.

No inconvenience of any importance will arise from leaving the wooden pannel square, while the door itself is circular; but if it should be thought better, the corners of the pannels may be taken off, or the wooden pannel may be made circular; this should not however be done till after the pannel has been fixed to the door. After this has been done, as the rivets will be sufficient to hold the sides of the frame in their places, the cutting off of the corners of the frame will produce no bad consequences.

I have been the more particular in my account of the manner of covering iron doors with wooden

pannels, for the purpose of confining heat, as this contrivance may be used with great advantage, not only for Roasters and Ovens, but also for a variety of other purposes; for the covers of large boilers for instance, for the doors of hot closets, steam closets, &c.

*Of Double Doors for Roasters, constructed of two circular pieces of Sheet-Iron seamed together.*

No difficulty will be found in the construction of these doors; and though they may not perhaps confine the heat quite so perfectly as the doors we have just described, they answer very well; and when the outside of the door is japanned, they have a very handsome and cleanly appearance.

There are two ways of constructing them, either of which may be adopted; the circular sheet of iron which forms the inside of the door, may be flat, and the outside sheet dishing; or the outside sheet may be flat, and the inside sheet dishing; but whichever of these methods is adopted, the hinges must be attached to the outside of the door; and care must be taken to make that part of the inside of the door quite flat which lies against the end of the Roaster, and closes it. The distance of the inside sheet of iron and the outside sheet, is not very essential; it should not however be less than one inch in the center of the door; and these two sheets should not touch each other any where, except



cept it be at their circumference, where they are fastened together. In the center of the outside sheet there should be fixed a knob of iron, or of brass, to serve as a handle for opening and shutting the door.

Double doors of this kind might easily be constructed of two circular pieces of cast iron, fastened together by rivets; or of one piece of cast iron, cast dishing, and a flat piece of sheet iron turned over it. When the latter construction is adopted, the cast iron must form the inside of the door, and its convex side must project into the Roaster. It should be quite flat near its circumference, in order that it may close the Roaster with accuracy, and it should be at least three quarters of an inch larger in diameter than the Roaster, in order that no part of the circular plate of sheet iron, which should be fastened to it by being turned over its edge, may get between it and the end of the Roaster.

*Of the Blow Pipes.*

THERE are various ways in which the Blow-Pipes may be fastened to the Roaster. The common method, when they are made of sheet iron, is to fasten them with rivets; but as blow-pipes of sheet-iron are liable to be burnt out in a few years, if much used, it is better to procure them of cast-iron from an iron-founder, in which case they should



be cast with flanches, and should be keyed on the inside of the Roaster; and their joinings with the bottom of the Roaster must be made tight with some good cement that will stand fire, and is proper for that use.

The effect of the blow-pipes will be considerably increased, if a certain quantity of iron wire, in loose coils, or of iron turnings, be put into them. These being heated by the fire, the air which passes through the tubes, coming into contact with them, will be more heated than it would be if the tubes were empty; but care must be taken that the quantities of these substances used, be not so great as to choke up the tube and obstruct too much the passage of the air.

The stoppers of the blow-pipes must be made to close them well, otherwise air will find its way through the blow-pipes into the Roaster at times when it ought not to be admitted. One of these stoppers, represented on a large scale, is seen drawn a little way out of its blow-pipe, in the figure 17; and in that figure, part of the iron strap is seen which supports the front ends of the two blow-pipes, and confines them in their places. This strap will not appear when the Roaster is set, for it will then be entirely covered and concealed by the brick-work.

Where blow-pipes are made of sheet iron, they should be so constructed and so fastened to the Roaster, that they may at any time be removed and replaced without taking the Roaster out of the brick-work. This is necessary, in order that they  
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may be taken away to be repaired or replaced with new ones, when by long use they become burnt out and unfit for service. If they be made with flanches, and keyed on the inside, and if they be supported in front on an iron strap of the form represented in figure 14, they may at any time be removed with little trouble, by unkeying them, and removing a few bricks. When the bricks in front, which it will be necessary to take away, are removed, this will open a passage into the fire-place sufficiently large to come at the wall at the farther end of the fire-place, which must come away in order to disengage the farther ends of the blow-pipes, which are fixed in it. This wall must be carefully built up again, after the new blow-pipes have been introduced and fastened to the Roaster.

*Of the Steam Tube.*

THIS is an essential part of the machinery of a Roaster, and must never be omitted. It should be situated somewhere in the upper part of the Roaster, but it is not necessary that it should be placed exactly at the top of it. It might perhaps be thought that a hole in the upper part of the door would serve the purpose of a steam-tube; but this contrivance would not be found to answer. A steam-tube, properly constructed, will have what is called *a draft* through it, which on some occasions will be found to be very useful,

but an hole in the door, unconnected with a tube could have no draft. It is absolutely necessary that there should be a damper in the steam-tube. The simplest damper is a circular plate of iron, a very little less in diameter than the tube, which, being placed in it, is moveable about an axis, which is perpendicular to the axis of the tube. This circular plate being turned about, and placed in different positions in the tube, by means of its axis, which, being prolonged, comes forward through the brick-work, the passage of the steam through the tube is more or less obstructed by it. This prolonged axis, which may be called the projecting handle of this damper, is represented in the figures 14, 15, and 17. This appears to me to be one of the simplest kind of dampers I am acquainted with; and it has this in particular to recommend it, that it may be regulated without opening any passage into the steam-tube, or into the Roaster, by which the air could force its way.

*Of the Dripping Pan.*

As the principal dripping-pan of a Roaster is destined for holding water, and as it is of much importance that it should not leak, it should be hammered out of one piece of sheet-iron, in the same manner as a frying-pan is formed; or if the metal be turned up at the corners, it should be lapped over, but not cut, and all rivetting-nails should be avoided, except such as can be placed  
very

very near the edge of the pan, and above the common level of the water that is put into it. To avoid the necessity of placing any rivetting-nail at the bottom of the pan, or near it, in fastening the sliders on which the pan runs, these sliders should be made to pass upwards, by the ends of the pan, in order to their being fastened to it near its brim.

The dripping pan should not be made quite so long as the Roaster, for room must be left between the farther end of it and the farther end of the Roaster, for the hot air from the blow-pipes to pass up into the upper part of the Roaster. In order to stop the dripping-pan in its proper place, when it is pushed into the Roaster, the farther end of the shelf on which it slides, may be turned upwards, and the brim of the dripping-pan made to strike against this projecting part of the shelf. The opening between this projecting part of the shelf, and the farther end of the Roaster, should be about one inch, or  $1\frac{1}{4}$  inches wide, and it may be just as long as the dripping-pan is wide at the brim. This part of the shelf which projects upwards, should be half an inch higher than the brim of the dripping-pan, in order to prevent the current of hot air from the blow-pipes from striking against the end of the dripping-pan, and heating it too much. The shelf may be stopped in its proper place, by means of two horizontal projecting slips of iron, about one inch, or  $1\frac{1}{4}$  inches long, each, at its farther end, which, striking against the end of the Roaster, will prevent the shelf from being pushed



pushed too far into it. The dripping-pan should have two falling handles, one at each end of it, which handles should have stops to hold them fast when they are raised into an horizontal position. As these handles will necessarily project a little beyond the ends of the pan, even when they are not raised up, the handle at the farther end of the pan will prevent the brim of the pan from actually touching the projecting end of the shelf; which circumstance will be advantageous, as it will serve to defend the end of the pan, and prevent its being so much heated as otherwise it would be by the hot air from below.

I find, on enquiry from several persons who have lately made the experiment, that it is by far the best method to use two dripping-pans, one within the other, with water between them. As the upper pan is very thin, being made of tin \* (tinned sheet iron) it is kept as cool as is necessary by the water; and the surface of the water being covered and protected, it does not evaporate so fast as when it is left exposed to the hot air in the Roaster.

*Of the Precautions that may be used to prevent the Dripping Pan from being too much heated.*

THIS is a very important matter, and too much attention cannot be paid to it by those who con-

\* Some persons have used a shallow earthen dish, instead of this second dripping-pan; but earthen ware does not answer so well for this use as tin, as it is more liable to be heated too much by the radiant heat from above.

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struft Roasters. From what has been said, it is evident, that if, in roasting meat, the water in the dripping-pan ever happens to be all evaporated, the drippings from the meat which fall on it cannot fail to fill the Roaster with noxious fumes. It is certainly not surprizing that those who, in roasting in a Roaster, neglected to put water into the dripping-pan, should not much like the flavour of their roasted meat.

There is a method of defending the dripping-pan from heat, which many have put in practice with success; but although it effectually answers the purpose, yet it is attended with a serious inconvenience, which, as it is not very obvious, ought to be mentioned. When the bottoms of Roasters were made flat, their dripping-pans were much more liable to be too much heated than they are when the body of the Roaster being made cylindrical, the dripping-pan is placed on a shelf in the manner I have here recommended. And several persons finding the water in the dripping-pans of their Roasters to boil away very fast, covered the (flat) bottoms of their Roasters with sand, or with a paving of thin tiles, or bricks. This produced the desired effect; but this contrivance occasions the bottom of a Roaster to be very soon burnt out and destroyed. The heat from the fire communicated to the under side of the bottom of the Roaster not being able to make its way upwards into the body of the Roaster, through the stratum of sand or bricks (which substances are non-conductors of heat) it is accumulated in the bottom of  
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the Roaster, and becomes there so intense as to destroy the iron in a short time.

The best method that can be adopted for preventing the dripping-pan from being too much heated, is to defend the bottom of the Roaster from the direct action of the fire, by interposing a screen of some kind or other between it and the burning fuel. This screen may be a plate of cast iron, about one third of an inch thick, with a number of small holes through it, supported upon iron bars at the distance of about an inch below the bottom of the Roaster;—or it may be formed of a row of thin flat tiles laid upon the blow-pipes, and supported by them.

Roasters which are made of a cylindrical form, will hardly stand in need of any thing to screen them from the fire; especially if their fire-places are situated at a proper distance below them, and if the size of the fire is kept within due bounds. But after all, if the person to whom the management of a Roaster is committed is determined to destroy it, no precautions can prevent it; and hence it appears how very necessary it is to secure the good will of the cooks. They ought certainly to wish well to the success of these inventions; for the introduction of them cannot fail to diminish their labour, and increase their comforts very much.

*Of large Roasters, that will serve to ROAST and  
BAKE at the same Time.*

IT has been found by experience that any Roaster may be made to roast and bake at the same time, in great perfection, when the proper precautions are taken; but this can best be done when the Roaster is of a large size, from 20 inches to 24 inches in diameter, for instance; for in this case there will be room above the meat for a shelf on which the things to be baked can be placed. And even when there is no roasting going on below it, any thing to be baked should be placed on this shelf, in order to its being nearer to the top of the Roaster, where the process of baking goes on better than any where else. In baking bread, pyes, cakes, &c. it seems to be necessary that the heat should *descend* in rays from the top of the oven, and as the intensity of the effects produced by the calorific rays which proceed from a heated body, is much greater near the hot body than at a greater distance from it, (being most probably as the squares of the distances inversely) it is evident why the process of baking should go on best in a low oven, or when the thing to be baked is placed near the top of the oven, or of the Roaster, when it is baked in a Roaster.

The shelf in the upper part of a Roaster for baking, may be made of a single piece of sheet-iron,

iron, but it will be much better to make it double, that is to say, of two pieces of sheet-iron, placed at a small distance from each other, and turned inwards, and fastened together at their edges, in the manner which will presently be more particularly described. This shelf, whether it be made single or double, should be placed upon ledges, rivetted to the sides of the Roasters; and to prevent the hot air from the blow-pipes from passing up between the farther end of this shelf and the farther end of the Roaster, the shelf should be pushed quite back against the end of the Roaster. It should be made shorter than the Roaster by about two inches, in order that there may be sufficient room between the hither end of the shelf and the inside of the door of the Roaster, for the vapour that ought to be driven out of the Roaster to pass upwards to the opening of the steam-tube. This shelf should not be fastened in its place, for it may sometimes, when very large pieces of meat are roasted, be found necessary to remove it.

As it seems probable that *radiant heat* from the top and sides of the Roaster, acts an important part, even in the process of roasting, if a Roaster of very large dimensions were to be constructed, I think it would be adviseable not to make its transverse section circular, but elliptical, the longest axis of the ellipse being in an horizontal position. This form would bring the top of the Roaster to be nearer to the meat than it would be if its form were cylindrical; its capacity remaining the same.



How far an horizontal shelf of sheet iron, placed immediately over the meat, and *very near it*, would answer as a remedy for the defect of a Roaster, the top of which, on account of its great size, should be found to be too far from the surface of the meat, I cannot pretend to determine, as I never have made the experiment; but I think it well deserving of a trial. If the farther end of this shelf were made to touch the farther end of the Roaster, so as to prevent the current of air from the blow-pipes from getting up between them, it is very certain that this hot air would be forced to impinge against the shelf, and run along the under side of it, to the hither end of the Roaster. The only question remaining, and which can only be determined by experiment, is, whether this hot air would heat the shelf *sufficiently*, or to that temperature which is necessary, in order that the iron may throw off those calorific rays which are wanted.

If this shelf were covered above with a pavement of tiles, or if it were constructed of two sheets of iron placed parallel to each other, at the distance of about one inch, turned in, or made dishing at their edges, and seamed together at their ends and sides in such a manner as to confine the air shut up between them, either of these contrivances, by obstructing the heat in its passage *through* the shelf, would promote its accumulation at its under surface, which would not only increase the intensity of the radiant heat where it is wanted,



ed, but, by diminishing the quantity of heat which passes *through* the shelf, would be very useful when any thing is placed on it in order to be baked.

Whenever a shelf is made in a Roaster, whether it be situated above the dripping-pan or below it, I think it would always be found advantageous to construct it in the manner here described, viz. of two sheets of iron, with confined air between them; or perhaps it may be still better to fill this cavity with finely pulverized charcoal. The additional expence of constructing the shelves of Roasters in this manner would be but trifling; and the passage of the heat *through them*, which it is always desirable to prevent as much as possible, will, by this simple contrivance, be greatly obstructed. If the lower shelf be so constructed, it will no doubt be found very useful in preventing the too quick evaporation of the water in the dripping-pan.

*Of various alterations that have been made in the forms of Roasters, and of the advantages and disadvantages of each of them.*

THE blow-pipes of all the Roasters that were constructed, till very lately, were made to pass round to the farther end of the Roaster; and after forming two right angles each, they entered the Roaster, in an horizontal direction, just above the level of the brim of the dripping-pan, in the manner represented in the figure 19.

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The figure 20 shows the manner in which the blow-pipes have been constructed of late.

The advantages of the former construction were, a great length of tube, and consequently a greater effect on that account; and a good direction to the current of hot air: the disadvantages were, the difficulty of removing the tubes to repair them, without unsettling the Roaster; and the difficulty of procuring blow-pipes of this form, of cast iron; and lastly, the great depth of space that was required for setting the Roaster.

The advantages of the blow-pipe, represented in figure 20, have already been noticed. The disadvantage from want of length, is compensated by a small increase of diameter. When this blow-pipe is fastened to the Roaster, its flanch is covered with a cement, and the vertical end of the pipe being introduced into the Roaster, through the circular hole in the bottom of it, which is made to receive it, a flat iron ring, covered with cement on its under side, is then slipped over the end of the tube within the Roaster, and a key of iron, in the form of a wedge, being passed through both sides of the tube, in holes prepared to receive it, by driving this wedgelike key with a hammer, the ring is forced downwards, and at the same time the flanch of the blow-pipe is forced upwards against the bottom of the Roaster, by which means the blow-pipe is firmly fixed in its place, and the cement makes the joinings air-tight. By removing this key, the pipe may at any time be removed without deranging the Roaster.

The figure 19 represents the section of a flat-bottomed Roaster. In this there is a shelf on which two pies are seen baking, and a piece of meat is represented lying on the gridiron.

In the figures 14 and 15, the front or hither end of the Roaster is represented as being turned over a stout iron wire. The first Roasters that were constructed were all made in a different manner. The hither end of the Roaster was rivetted to a broad flat frame, constructed of stout plate iron; and to this frame, or flat front, which projected before the brick-work, the hinges and turn-buckles of the door were fastened. An idea of this manner of constructing the front of a Roaster may be formed from the figure 21, although this figure does not represent the front of a Roaster, but that of an oven, which will be described presently.

There is no objection to this method of constructing Roasters, but the expence of it.

*Of some attempts to simplify the Construction of the Roaster.*

FINDING that much more heat was always communicated to the under sides of Roasters, especially as they were first constructed (with flat bottoms) than was there wanted, meditating on the means I could employ to defend the bottom of the dripping-pan from this excessive heat, without, at the

the same time, exposing the bottom of the Roaster to the danger of being soon destroyed, in consequence of the accumulation of it, on its passage upwards being prevented; it occurred to me, that if the bottom of the Roaster were covered with a shallow iron pan turned upside down, with a row of holes from side to side at the farther end of it, and if a certain quantity of fresh air could occasionally be admitted under this inverted pan; this cold air, on coming into contact with the bottom of the Roaster would take off the heat, and becoming specifically lighter on being heated, would pass upwards through the holes at the farther end of this pan into the Roaster, serving at the same time three useful purposes, namely, to defend the dripping-pan;—to cool the bottom of the Roaster;—and to assist in heating the inside of the Roaster, above, where heat is most wanted. This invention was put in practice, and was found to answer very well all the purposes for which it was contrived. It was likewise found, that with proper management the current of heated air from below the inverted pan might be so regulated, as to roast meat very well without making any use of the blow-pipes; and consequently that Roasters might be constructed without blow-pipes.

As the substitution of the contrivance above described in lieu of the blow-pipes would simplify the construction of the Roaster very much, and enable tradesmen to afford the article at a much lower price, I took a great deal of pains to find out

whether a Roaster on this simple construction could be made to perform as well as those which are made with blow-pipes. I caused one of them to be put up in my own house, and tried it frequently; and I engaged several of my friends to try them; and they were found to answer so well, that I ventured at length to recommend it to manufacturers to make them for sale. As they were called Roasters, and as they cost little more than half what those with blow-pipes were sold for, many persons preferred them on account of their cheapness, and more than two hundred of them have already been put up in different parts of the country, and I am informed that they have answered to the entire satisfaction of those who have tried them.

Although they are undoubtedly inferior in some respects to Roasters which are furnished with blow-pipes, meat may, with a little care and attention, be roasted in them in very high perfection; and as nothing can possibly answer better than they do for all kinds of baking, they will, I am persuaded, find their way in due time into common use.

Roasters on this simple construction (without blow-pipes) which I shall call *Roasting Ovens*, were at first made with flat bottoms, but of late they have been made cylindrical; and as I think the cylindrical form much the best in many respects, I shall give a description of one of them.

Figure 21 represents a front view of a cylindrical Roasting-Oven with its door shut. The front  
end



end of the large cylinder, which constitutes the body of this oven, instead of being turned over a stout wire, is turned outwards, and rivetted to a flat piece of thick sheet iron, which in this figure is distinguished by vertical lines, and which I shall call *the front* of the oven.

The door of the oven is distinguished by horizontal lines. The general form of the front of the oven is circular; but it has two projections on opposite sides of it, to one of which the hinges of the door, and to the other the turnbuckles for fastening it when it is closed, are fastened. It has another projection above, which serves as a frame to the doorway, through which a brush is occasionally introduced for the purpose of cleaning the flues. On one side of this projection there is a small hole, which is distinguished by the letter *a*, through which the handle or projecting axis of the circular register of the vent-tube (which is not seen) passes.

In the body of the oven, at the distance of half its semi-diameter below its center or axis, there is an horizontal shelf, which is fixed in its place, not by resting on ledges, or by being rivetted to the sides of the oven, but by its hither end being turned down, and firmly rivetted to the vertical plate of iron, which I have called the front of the oven. This shelf, which should be made *double* to prevent the heat from passing through it from below, must not reach quite to the farther end of the oven: there must be an opening left, about one inch in width, between the end of it and the

farther end of the oven, through which opening the air heated below the shelf will make its way upwards into the upper part of the oven.

From what has been said, it will be evident that the hollow space below the shelf we have just been describing, which I shall call the *air-chamber*, is intended to serve in lieu of the blow-pipes of a Roaster; and this office it will perform tolerably well, provided means are used for admitting cold air into it, from without, occasionally. This is done by means of a register, which is situated at the lower part of the vertical front of the Roaster, a little below the bottom of the door. This register is distinctly represented in the figure 21.

Figure 22, which represents a vertical section of the oven through its axis, shows the (double) door of the Roaster shut, and the two dripping-pans, one within the other, standing on the shelf we have just been describing, and a piece of meat above them, which is supposed to be laying on a gridiron placed in the second dripping-pan. The register of the air-chamber, below the shelf, which supplies the place of the blow-pipes, is represented as being open; and a part of the steam-tube is shown, through which the steam and vapour are driven out of the oven, by the blast of hot air from the air-chamber.

The cylinder which constitutes the body of the oven, is two feet long, and is supposed to be of cast iron. It is cast with a flanch, which projects outwards about one inch at the opening of the cylinder,

linder, by means of which flanch it is attached, by rivets, to the front of the oven, which, as I have already observed, must be made of strong sheet iron, which may be near one-eighth of an inch in thickness.

As the shelf is not attached to the sides of the oven, but to its *front*, the body of the oven need not be perforated, except in one place, namely, where the steam goes off; and as the bottom, or farther end of the cylinder, and the flanch at its hither end, and the cylinder itself, are all cast at the same time, and as the form of the oven is such as will deliver well from the mould, it appears to me that the article might be afforded at a low price, especially in this country, where the art of casting in iron is carried to so high a pitch of perfection.

The shelf might easily be made of cast iron, as might also the dripping-pans and the double door of the oven; and I should not be surprized if English workmen should succeed in making even the front of the oven, and the register of the air-chamber, and every other part of the machinery, of that cheap and most useful metal.

If the shelf be made of cast iron, to save the trouble of rivetting in making it double, it may be covered by an inverted shallow pan of cast iron, and in the bottom of this pan, which will be uppermost when it is inverted, there may be cast two shallow grooves, both in the direction of the length of the pan, and consequently parallel to

each other, in which grooves (which may be situated about an inch from the sides of the inverted pan) two parallel projections at a proper distance from each other, cast at the bottom of the lower dripping-pan, may pass. These projections passing freely in the grooves which receive them, will serve to keep the dripping-pan steady in its proper direction when it is pushed into or drawn out of the oven.

To increase the effect of the air-chamber when this oven is used for roasting meat, a certain quantity of iron wire, in loose coils, or of iron turnings, may be put into the air-chamber.

The door of the oven, which is very distinctly represented in the figure 21, should be about 19 inches in diameter, if the oven is 18 inches in diameter within, or in the clear. In this figure the internal edge or corner of the hither end of the body of the oven is indicated by a dotted circle, and the position of the shelf is pointed out by an horizontal dotted line.

In fastening the vertical plate, which forms the front of the oven, to the projecting flanch at the hither end of the cylindrical body of the oven, care must be taken to beat down the heads of the rivetting nails in front, otherwise they will prevent the door of the oven from closing it with that nicety which is requisite.

In setting this *Roasting-Oven*, the whole of the thickness of the vertical front of it should be made to project forward before the brick-work.

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The fire-place doors, ash-pit, register-door, damper in the chimney, &c. should be similar in all respects to those used for Roasters; and the flues should likewise be constructed in the same manner.

I have been the more particular in my description of this *Roasting-Oven*, because I think it bids fair to become a most useful implement of cookery. As an oven it certainly has one advantage over all ovens constructed on the common principles, which must give it a decided superiority; by means of the air-chamber and the steam-tube it may be kept clear of all ill-scented and noxious fumes, without the admission of cold air.

*Of the Difference between a Roasting-Oven and a Roaster.*

FROM the account of the Roasting-Oven that has just been given, it might be imagined that it possesses all the properties of the Roaster, and in the same degree; but this is not the case. The essential difference between them is this; the blow-pipes of the Roaster being surrounded by the flame on all sides, they are heated *above* as well as below, and the air in passing through them is much more exposed to the heat than it is in passing through the air-chamber of the Roasting-Oven. The particles of air which happen to come into contact with the bottom of the oven will of course be heated; but if, in consequence of their acquired lightness on being heated, they rise upwards



wards to the top of the air-chamber, they will there come in contact with the bottom of the shelf, which, instead of communicating more heat to them, will deprive them of a part of that which they bring with them from below; but circumstances are very different in the blow-pipes of a Roaster; in them, the particles of air acquire continually additional heat from every part of the surface with which they come into contact in their passage through the tube.

From this view of the subject, we see how very essential it is that the shelf of a Roasting-Oven should be so composed or constructed, that heat may not readily find its way *through it*; and we see likewise how necessary it is to manage the registers of blow-pipes and of air-chambers with proper care.

## CHAPTER VI.

*Of the usefulness of small Iron Ovens, and of the best methods of constructing them, and managing them—Reasons why they have not succeeded in many cases where they have been tried—Ovens may be used for other processes of cookery besides baking—Curious results of some attempts to boil meat in an oven—Explanation of these appearances—Conjectures respecting the origin of some national customs.*

**I**N the First Part of this Tenth Essay, I recommended small iron ovens for cottagers, and nests of small ovens for the kitchens of large families; and I have had occasion to know since, that several persons have adopted them. I have likewise been made acquainted with the results of many of the trials that have been made of them, and with the complaints that have been brought against them. As I am more than ever of opinion that iron ovens will always be found useful when they are properly constructed and properly managed, I shall in this place add a few observations to what I have already published concerning them.

And in the first place I must observe, that a *small* iron oven stands in need of a good door; that is to say, of a door well contrived for confining heat; and the smaller the oven is, so much  
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the more necessary is it that the door should be good.

The door must not only fit against the mouth of the oven with accuracy, but it must be composed of materials through which heat does not easily make its way.

An oven door constructed of a single sheet of plate iron, will not answer, however accurately it may be made to fit the oven, for the heat will find its way *through it*, and it will be carried off by the cold air of the atmosphere, which comes into contact with the outside of it. The bottom of the oven may be made hot by the fire under it; but the top and sides of it cannot be properly heated, while there is a continual and great loss of heat through its door. But an oven, to perform well, must be very equally heated in every part of it.

If the flame and smoke of the fire be made to surround an oven on every side, and if the fire be properly managed, there can be no difficulty in heating an iron oven equally, and of keeping it at an equal temperature, provided the loss of heat by and *through* the door be prevented.

If the door be constructed of sheet iron, it must either be made *double*, or it must be covered on the outside with a pannel of wood. By a *double door*, I do not here mean *two doors*, but one door constructed of two sheets or plates of iron, placed parallel to and at a certain distance from each other; and so constructed, that the air which is between the two plates may be shut up and confined. The two plates or sheets

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of

of iron, of which the double door of an oven is made, must not touch each other, except at their edges (where they must join in order to their being fastened together) for were they to lie one flat upon the other, the heat would pass too rapidly through them, notwithstanding there being two of them ; but it is not necessary that they should be farther asunder than an inch, or an inch and an half. One of the plates may be quite flat, and the other a little convex. The end of the oven must be made quite flat, or level, so as to be perfectly closed by a flat surface placed *against* it. The door is that flat surface ; and the greatest care must be taken that it apply with accuracy, or touch the end of the oven in every part, when it is pressed against it ; for if any opening be left, especially if it be near the top of the oven, the hot air in the oven will not fail to make its escape out of it.

It never should be attempted to make the door of an oven or of a closed fire place fit, by causing it to *shut into a rabbet*. That is a very bad method ; for besides the difficulty of executing the work with any kind of accuracy, the expansion of the metal with heat is very apt to derange the machinery, when the door is so constructed.

From what has been said of the necessity of causing the door of an oven to fit with accuracy, it is evident that care must be used to place its hinges properly ; and I have found, by experience, that such a door is closed more accurately by two turn-buckles, placed at a proper distance from each other, than by a single latch. I beg pardon for repeating what has already been said elsewhere.

*Of the Management of the Fire in heating an Iron Oven.*

IF a certain degree of attention is always necessary in the management of fire, there is certainly nothing on which we can bestow our care that repays us so amply; and with regard to the trouble of managing a fire in a closed fire-place, it is really too inconsiderable to deserve being mentioned.

Whenever a fire is made under an iron oven, in a closed fire-place, constructed on good principles, there is always *a very strong draft* or pressure of air into the fire place; and this circumstance, which is unavoidable, renders it necessary to keep the fire-place door constantly closed, and to leave but a small opening for the passage of the air through the ash-pit register. The fire-place too should be made very small, and particularly the bottom of it, or the grate on which the fuel burns.

If any of these precautions are neglected, the consequences will be,—the rapid consumption of the fuel,—the sudden heating and burning of the bottom of the oven,—and the sudden cooling of the oven as soon as the fire-place ceases to be filled with burning fuel.

It is a fact which ought never to be forgotten,  
“ that of the air that forces its way into a closed  
“ fire-place, that part only which comes into  
“ actual contact with the burning fuel, and is de-  
“ composed by it in the process of combustion,  
“ contributes



“ contributes any thing to the heat generated ;  
“ and that all the rest of the air that finds its way  
“ into and *through* a fire-place, is a thief, that steals  
“ heat, and flies away with it up the chimney.”

The draft occasioned by a fire in a closed fire-place being INTO THE CHIMNEY and not into the fire, cold air is as much disposed to rush in *over* the fire, as through it, and it violently forces its way into the hot fire-place by every aperture, even after all the fuel is consumed, carrying the heat away with it up the chimney and into the atmosphere. It even makes its way between the bars of the grate whenever they are not quite covered with burning fuel : hence it appears how necessary it is to make the grate of a closed fire-place small, and to give to that part of the fire-place which is destined for holding the fuel, the form of an inverted truncated cone or pyramid, or else to make it very deep in proportion to its length and width.

But the prevention of the air from finding its way through the fire-place without coming into contact with the burning fuel, is not the only advantage that is derived from constructing closed fire-places in the manner here recommended ; it serves also to increase the intensity of the heat in that part of the fire-place which contains the fuel, which tends very powerfully to render the combustion of the fuel complete, and consequently to augment the quantity of heat generated in that process.

To prevent the bottom of the oven (or boiler)  
from

from being too much affected by this intense heat, nothing more is necessary than to make the fire-place *sufficiently small*, and to place it at a sufficient distance below the bottom of the oven. It will be indispensably necessary however with such a (small) fire-place, situated far below the bottom of an oven, to keep the fire-place door *well closed*, otherwise so much cold air will rush in *over the fire*, that it will be quite impossible to make the oven hot.

I have found by recent experiments, that a fire-place in the form of an oblong square or prism, six inches wide, nine inches long, and six inches deep, is sufficient to heat an iron oven 18 inches wide, 24 inches long, and from 12 to 15 inches in height; and that the grate of this fire-place should be placed about 12 inches below the bottom of the oven. More effectually to prevent the fire from operating with too much violence upon any one part of the bottom of the oven, the brick-work may be so sloped outwards and upwards on every side from the top of the burning fuel to the extreme parts of the sides and ends of the bottom of the oven, that the whole of the bottom of the oven may be exposed to the direct rays from the fire.

In some cases I have suffered the flame to pass freely up both sides of the oven to the top of it, and then caused it to descend by the end of the oven to the level of its bottom, or rather below it, and from thence to pass off by an horizontal canal into the chimney; and in other cases I have caused it to pass backwards and forwards in horizontal  
canals

canals by the sides of the oven, before I permitted it to go off into the chimney. Either of these methods will do very well, provided the smoke be made to *descend* after it has left the top of the oven, till it reaches below the level of the bottom of it, before it is permitted to pass off into the chimney; and provided the canal by which the smoke passes off be furnished with a damper.

In setting an oven provision should be made, by leaving holes, to be stopped up with stoppers, for occasionally cleaning out all the canals in which the smoke is made to circulate; and in order that these canals may not too often be choaked up with soot, they should never be made less than two inches wide, even where they are very deep or broad; and where they are not more than four or five inches deep, they should be from three to four inches wide, otherwise they will be very often choaked up with soot.

To clean out the flues of an Oven, Roaster, or large fixed boiler, a strong cylindrical brush may be used, which may have a flexible handle made of three or more iron wires, about  $\frac{1}{8}$  or  $\frac{1}{16}$  of an inch in diameter, twisted together.

Holes closed with fit stoppers must of course be left in the brick-work for occasionally cleaning out these flues.

If the iron door of an oven be made double, the outside of it may with safety be japanned black or white, which will prevent its rusting, and add much to the cleanliness and neatness of the appearance of the kitchen.

These details may by some be thought unimportant and tiresome ; but those who know how much depends on minute details in the introduction of new mechanical improvements, will be disposed to excuse the prolixity of these descriptions. I wish I could make my writings palatable to the generality of readers, but that I fear is quite impossible. My subjects are too common and too humble to excite their curiosity, and will not bear the high seasoning to which modern palates are accustomed.

A great disadvantage under which I labour is, that of those who *might* profit most from my writings, many *will not read*, and others *cannot*.

But to return to my subject. To save expence, small ovens for poor families may be closed with flat stones, or with tiles ; and the fire-place door for such an oven, and its ash-pit register, may be made of common bricks placed edgewise, and made to slide against those openings.

There is a circumstance respecting the iron ovens I am describing, which is both curious and important. The fire-place for an oven of the smallest size should be nearly as capacious as one which is destined for heating a much larger oven ; and I have found by repeated experiments, that a nest of four small ovens, set together, and heated by the same fire, will require but very little more fuel to heat them than would be necessary to heat one of them, were it set alone. An attentive consideration of the manner in which the heat is applied—of the smallness of the quantity, in all cases, that is applied to the heating of the contents of the oven—

and



and the much greater quantity that is expended in heating the fire-place and the flues, will enable us to account for this curious fact, in a manner that is perfectly philosophical and satisfactory.

A cottage oven, 11 inches wide, 10 inches high, and 16 inches long, will require a fire-place five inches wide, five inches high, and seven inches long; and for *four* of these ovens, set together in a nest, the fire-place need not be more than six inches wide, six inches high, and eight inches long.

I have in my house at Brompton two iron ovens, each 18 inches wide, 14 inches high, and 24 inches long, set one over the other, and heated by the same fire; and their fire-place is only six inches wide, six inches high, and nine inches long.

If the fire-place of an iron oven be properly constructed, and if the fire be properly managed, it is almost incredible how small a quantity of fuel will answer for heating the oven, and for keeping it hot. But if the fire-place door be allowed to stand open, and a torrent of cold air be permitted to rush into the fire-place and through the flues, it will be found quite impossible to heat the oven properly, whatever may be the quantity of fuel consumed under it; and neither the baking of bread, nor of pies, nor any other process of cookery, can be performed in it in a suitable manner.

A very moderate share indeed of ingenuity is required in the proper management of a fire in a closed fire-place, and very little attention; and as it requires no bodily exertion, but saves labour, and



expencc, and anxiety ; and as moreover it is an interesting and amusing occupation, attended by no disgusting circumstance, and productive of none but pleasing, agreeable, and useful consequences ; we may, I think, venture to hope, that those prejudices which prevent the introduction of these improvements, will in time be removed.

It is not obstinacy, it is that *apathy* which follows a total corruption of taste and morals, that is an *incurable* evil ;—for that, alas ! there is no remedy, but calamity and extermination.

*Ovens may be used in boiling and stewing, and also in warming rooms.*

THERE are so many different ways in which the heat necessary in preparing food may be applied, that it would not be surprising if one should sometimes be embarrassed in the choice of them ; and I am not without apprehension, that I may embarrass my readers by describing and recommending so many of them. The fact is, they all have their different kinds of merit, and in the choice of them regard must always be had to the existing circumstances.

Desirous of contriving a fire-place on as simple a construction as possible, that should serve at the same time for heating a room, and for the performance of all the common processes of cookery for a small family, and which moreover should  
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not be expensive, nor require much attendance, I caused four small iron ovens to be set in the opening of a common chimney fire-place. Those ovens, which were constructed of sheet iron, and were furnished with doors of the same sheet iron, each covered with a pannel of wood to confine the heat, were 16 inches long, 11 inches wide, and 10 inches high each; and they were set in brick-work in such a manner, that the fronts of the doors of the ovens being even with the side of the room, the original opening of the chimney fire-place, which was large, was completely filled up. These ovens were all heated by one small fire, the closed fire-place being situated about 12 inches below the level of the bottoms of the two lowermost ovens, and perpendicularly under the division between them, and the passage into the fire-place was closed by a fit stopper.

From this description, it will not be difficult for any person who has perused the preceding chapters of this essay, to form a perfect idea of this arrangement; and it is equally easy to perceive, that had not the open chimney fire-place, in which these four ovens were set, been very large, I should have been under the necessity of enlarging it, or at least of raising its mantle, in order to have been able to introduce these ovens, and set them at proper distances from each other.

I shall now proceed to give an account of the experiments that were made with this fire-place.

My first attempt was to warm the room by

means of it. A small fire being made in its closed fire-place, its oven doors were all set wide open, and the room, though by no means small, soon became very warm. This warming apparatus was now, to all intents and purposes, a German stove. By shutting two of the oven doors, the heat of the room was sensibly diminished; and by leaving only one of them open, it was found that a moderate degree of warmth might be kept up, even in cold weather.

As no person in this country would be satisfied with any fire-place, if in its arrangement provision were not made for boiling a tea-kettle, I caused a very broad shallow tea-kettle, with a bottom perfectly flat, to be constructed of common tin, and filling it with cold water, placed it in one of the two lower ovens, and shut the oven door. Although the fire under the ovens was but small, it burnt very bright, and the water in the tea-kettle was soon made to boil.

I was not surprized that the water boiled in a short time, for it was what I expected; but on removing the tea-kettle I observed an appearance which did surprize me, and which indicated a degree of heat in the oven which I had no idea of finding there. The handle of the tea-kettle resembled very much, in form, the handle of a common tea-kettle, but, like the rest of the kettle, was constructed of tin, or, to speak more properly, of tinned sheet iron.

On removing the kettle from the oven I found

that the tin on its handle had been melted, and had fallen down in drops, which rested on the body of the kettle below, where they had congealed, having been cooled by the water in the kettle.

This discovery convinced me that I should not fail of obtaining in these ovens any degree of heat that could possibly be wanted in any culinary process whatever: it showed me likewise that degrees of temperature, much higher than that of boiling water, may exist in a closed oven in which water is boiling; and it seemed to indicate, that all the different culinary processes of boiling, stewing, roasting, and baking, might be carried on at the same time in one and the same oven. Subsequent experiments have since confirmed all these indications, and have put the facts beyond all doubt. These facts are certainly curious, and the knowledge of them may lead to useful improvements; for they may enable us to simplify very much the implements used in cookery.

Having found that I could boil water in my small ovens, my next attempt was to boil meat in them. I put about three pounds of beef, in one compact lump, into an earthen pot, and filling the pot to within about two inches of its brim with cold water, I set it in one of the lower ovens, shutting the door of the oven, and keeping up a small steady fire in the fire-place. In about two hours and three-quarters the meat was found to be sufficiently boiled; and all those who partook of it (and they were not fewer than nine or ten persons) agreed in



thinking it perfectly good and uncommonly savory. On my guard against the illusions which frequently are produced by novelty, I should have had doubts respecting the reality of those *superior qualities* ascribed to this boiled beef, had not an uncommon appearance in the water in which it had been boiled attracted my attention. This water, after the meat had been boiled in it, appeared to be nearly as transparent and as colourless as when it was brought from the pump. It immediately occurred to me, that this effect could be owing to nothing else but to the state of perfect quiet in which the water must necessarily have been during the greater part of the time it remained in the oven; and to determine whether this was really the case, or not, I made the following decisive experiment:

Having provided two equal pieces of beef from the same carcase, I put them into two stew-pans of nearly the same form and dimensions; one of them which had a cover, being constructed of earthen ware, while the other, which had no cover, was made of copper.

Into these stew-pans I now put equal quantities of water, with this difference however, that while the water put into the copper stew-pan was cold, that put into the other was boiling hot. A small fire being now made in the fire-place, these two stew-pans, with their contents, were introduced into the two lower ovens. The earthen stew-pan was set down upon a ten-inch tile, which had previously been placed in the oven, to serve as a support



support for it, in order to prevent the bottom of the stew-pan from coming into immediate contact with the bottom of the oven, and the door of that oven was shut; but the copper stew-pan was set down immediately on the bottom of its oven, and the door of that oven was left open during the whole time the experiment lasted.

At the end of three hours, the stew-pans were taken out of the ovens, and their contents were examined. The appearances were just what I expected to find them. The meat in each of the stew-pans was sufficiently boiled, but there was certainly a very striking difference in the appearance of the liquor remaining in the two utensils; and if I was not much mistaken, there was a sensible difference in the taste of the two pieces of meat; that boiled in the earthen stew-pan being the most juicy and *most* savory. The water *remaining in* this vessel—and little of it had evaporated—was still very transparent and colourless, and nearly tasteless, while the liquor in the copper stew-pan was found to be a rich meat-broth.

The result of this experiment recalled very forcibly to my recollection a dispute I had had several years before, in Germany, with the cook of a friend of mine, who, at my recommendation, had altered his kitchen fire-place; in which dispute I now saw I was in the wrong, and seeing it, felt a desire more easy to be conceived than to be described, to make an apology to an innocent person whom I had unjustly suspected of wilful misrepresentation.

representation. This woman (for it was a female cook) on being repeatedly reprimanded for sending to table a kind of soup of inferior quality, which, before the kitchen was altered, she had always been famous for making in the highest perfection, persisted in declaring that she could not make the same good rich soup in the new fashioned boilers (fitted up in closed fire-places, and heated by small fires) as she used to make in the old boilers, set down upon the hearth before a great roaring wood fire.

The woman was perfectly in the right. To make a rich meat soup, the juices must be washed out of the meat, and intimately mixed with the water; and this washing out in boiling must be greatly facilitated and expedited by the continual and rapid motion into which the contents of a boiler are necessarily thrown when heat is applied to one side of it only, especially when that heat is sufficiently intense to keep the liquid continually boiling with vehemence. I ought, no doubt, to have foreseen this; but how difficult is it to foresee anything!—It is much easier to explain than to predict.

If it be admitted that fluids in receiving and giving of heat are necessarily thrown into internal motions, in consequence of the changes of specific gravity in the particles of the fluid, occasioned by the alteration of their temperatures, we shall be able to account, in a manner perfectly satisfactory, not only for the appearances observed in the experiments

riments above mentioned, and for the superior richness of the soup made by the Bavarian cook in her boiler, but also for several other curious facts.

When the copper stew-pan, containing cold water and a piece of meat, was put into an iron oven, heated by a fire situated below it, as the bottom of the oven on which the stew-pan was placed was very hot, the heat passing rapidly through the flat bottom of this metallic utensil, communicated heat to the lower stratum of the water, which, becoming specifically lighter on being thus heated was crowded out of its place, and forced upwards, by the superincumbent colder and consequently heavier liquid:—This necessarily occasioned a motion in every part of the fluid, and this motion must have been rapid in proportion as the communication of heat was rapid; and it is evident that it could never cease, unless all the water in the stew-pan could have acquired and preserved an equal and a permanent temperature, which, under the existing circumstances, was impossible; for as the door of the oven was left open, the upper surface of the water was continually cooled by giving of heat to the cold atmosphere, which, rushing into the oven, came into contact with it; and as soon as the water was made boiling hot, an internal motion of another kind was produced in it, in consequence of the formation and escape of the steam; which last motion was likewise rapid, and violent in proportion to the rapidity

pidity of the communication of heat. Hence we see that the water in the copper stew-pan must have been in a state of continual agitation from the time it went into the oven till it came out of it; and the state in which this liquid was found at the end of the experiment, was precisely that which might have been expected, on a supposition that these motions would take place. Let us now see what, agreeably to our assumed principles, ought to have taken place in the other stew-pan.

In this case its contents having been nearly boiling hot when the stew-pan was put into the oven, and the door of the oven having been kept closed, and the stew-pan covered with its earthen cover, and the stew-pan being moreover earthenware, which substance is a very bad conductor of heat, and being placed, not immediately on the bottom of the oven, but on a thick tile, every circumstance was highly favourable, not only for keeping up the equal heat of the water, but also for preventing it from receiving additional heat so rapidly as to agitate it by boiling. There is therefore every reason to think that the water remained at rest, or nearly so, during the whole time it was in the oven: and the transparency of this fluid, at the end of the experiment, indicated that little or none of the juices of the meat had been mixed with it.

When the Bavarian cook made soup in her own way, the materials (the meat and water) were put into a tall cylindrical boiler, and this boiler was set down upon the hearth *against* a wood fire, in



such a manner that the heat was applied to *one side only* of the boiler, while the other sides of it were exposed to the cold air of the atmosphere; consequently the communication of the heat to the water produced in it a rapid circulatory motion; and when the water boiled, this motion became still more violent. And this process being carried on for a considerable length of time, the juices of the meat were so completely washed out of it, that what remained of it were merely tasteless fibres: but when the ingredients for this meat soup, taken in the same proportions, were cooked during the same length of time in a boiler set in a closed fireplace, and heated by a small equal fire; this moderate heat being applied to the boiler on every side at the same time, while the loss of heat at the surface of the liquid was effectually prevented by the double cover of the boiler, the internal motions in the water, occasioned by its receiving heat, were not only very gentle, but they were so divided into a vast number of separate ascending and descending small currents, that the mechanical effects of their impulse on the meat could hardly be sensible; and as the fire was so regulated that the boiling was never allowed to be at all vehement (the liquid being merely kept gently simmering) after the contents of the boiler were once brought to the temperature of boiling, the currents occasioned by the heating ceased of course, and the liquid remained nearly in a state of rest during the remainder of the time that the process



process of cooking was continued ; the soup was found to be of a very inferior quality, but on the other hand the meat was uncommonly juicy and savory.

These minute investigations may perhaps be tiresome to some readers ; but those who feel the importance of the subject, and perceive the infinite advantages to the human species that might be derived from a more intimate knowledge of the *science* of preparing food, will be disposed to engage with cheerfulness in these truly interesting and entertaining researches : and such readers, and such only, will perceive that it has not been without design, that in chapters devoted to the explanation of subjects the most humble, I have frequently introduced obtruse philosophical researches, and the results of profound meditation.

I am not unacquainted with the manners of the age. I have lived much in the world, and have studied mankind attentively ; and am fully aware of all the difficulties I have to encounter in the pursuit of the great object to which I have devoted myself. I am even sensible, fully sensible, of the dangers to which I expose myself.—In this selfish and suspicious age it is hardly possible that justice should be done to the purity of my motives ; and in the present state of society, when so few who have leisure can bring themselves to take the trouble to read any thing except it be for mere amusement, I can hardly expect to engage attention.

tion. I may write ; but what will writing avail if nobody will read. My bookseller, indeed, will not be ruined, as long as it shall continue to be *fashionable* to have *fine libraries*. But my object will not be attained, unless my writings are read ; and the importance of the subjects of my investigations are felt.

Persons who have been satiated with indulgences and luxuries of every kind, are sometimes tempted by the novelty of an untried pursuit. My best endeavours shall not be wanting to give to the objects I recommend, not only all the alluring charms of novelty, but also the power of procuring a pleasure as new, perhaps, as it is pure and lasting.

How might I exult, could I but succeed so far as to make it *fashionable* for the rich to take the trouble to *choose for themselves* those enjoyments which their money can command, instead of being the dupes of those tyrants, who, in the garb of submissive fawning slaves, not only plunder them in the most disgraceful manner, but render them at the same time perfectly ridiculous, and fit for that destruction which is always near at hand, when good taste has been driven quite off the stage.

When I see, in the capital of a great country, in the midst of summer, a coachman sitting on a coach-box, dressed in a thick heavy great coat with sixteen capes, I am not surprized to find the coach door surrounded by a groupe of naked beggars.

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We should tremble at such appearances, did not the shortness of life, and the extreme levity of the human character, render us insensible to dangers while at any distance ; however great, and impending, and inevitable they may be.

But to return from this digression.

It is frequently useful, and is always amusing, to trace the differences in the customs and usages of different countries to their causes. The French have for ages been remarkable for their fondness for soups, and for their skill in preparing them : now as national habits of this kind must necessarily originate at a very early period of society, and must depend on peculiar local circumstances, may not the prevalence of the custom of eating soup in France be ascribed to the open chimney fire-places and wood-fires, which have ever been common in that country ?

It is certain that in the infancy of society, before the arts had made any considerable progress, families cooked their victuals by the same fire which warmed them. Kitchens then were not known ; and the utensils used in cooking were extremely simple, an earthen pot perhaps set down before the fire. We have just seen, that with such an apparatus, soups of the very best qualities would naturally be produced ; and it is not surprizing, that a whole nation should acquire a fondness for a species of food, not only excellent in its kind, but cheap, nutritious, and wholesome, and easily prepared.

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Had coals been the fuel used in France, it is not likely that soups would have been so generally adopted in that country ; for a common coal fire is not favourable for making good soups ; although with a little management the very best soups may be made, and every other process of cookery be performed, *in the highest perfection*, with any kind of fuel.

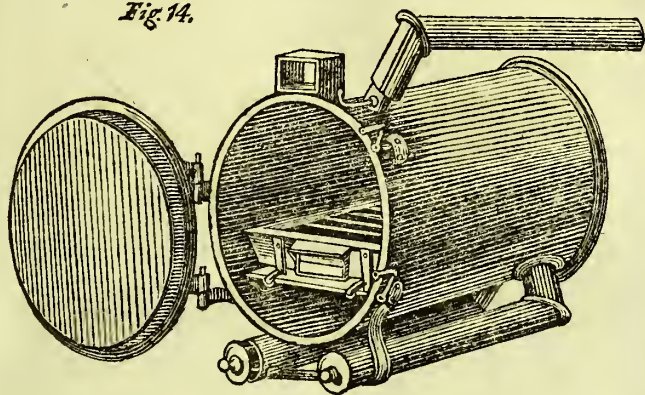
When the *science* of cookery is once well understood, or an intimate knowledge is acquired of the precise nature of those chemical and mechanical changes which are produced in the various culinary processes, we may then, and not till then, take measures with certainty for improving the *art* of preparing food. Experience, unassisted by science, may lead, and frequently does lead to useful improvements ; but the progress of such improvement is not only slow, but vacillating, uncertain, and very unsatisfactory. On that account no doubt, it is, that men of science have in all ages been respected as valuable members of society.

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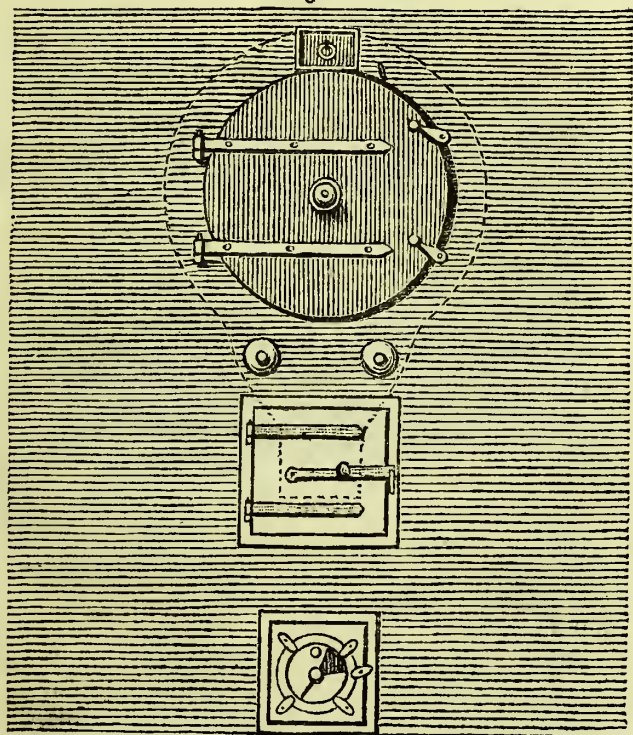




*Fig. 14.*

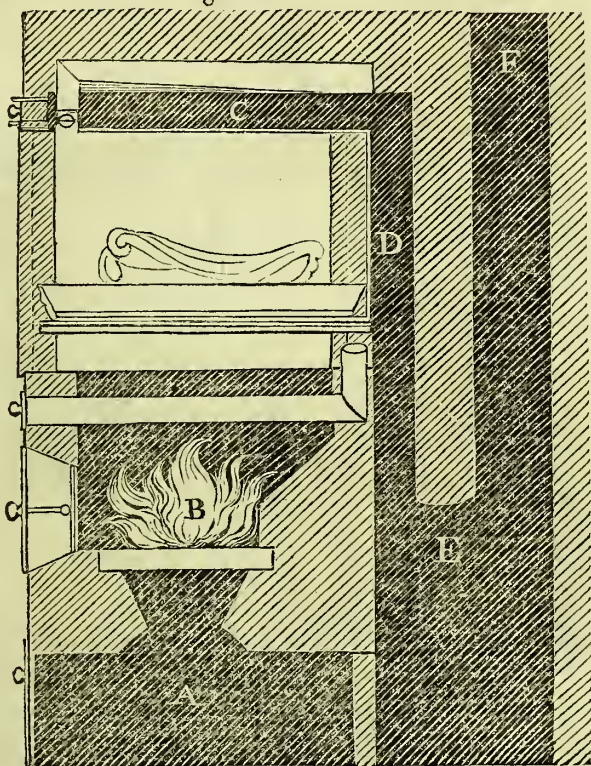


*Fig. 15.*





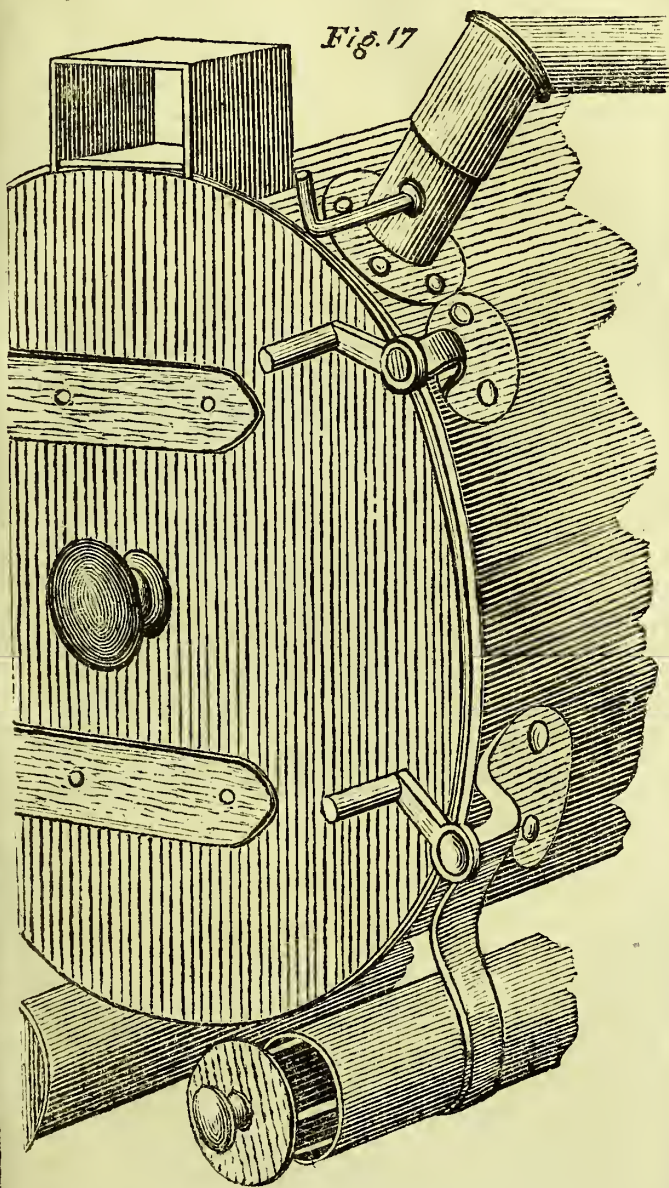
*Fig. 16.*







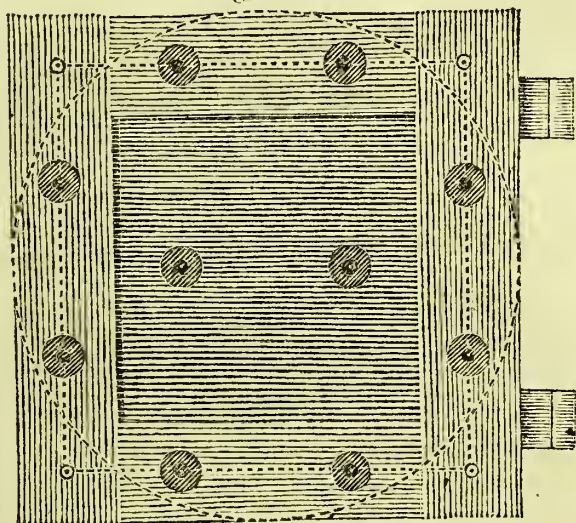
*Fig. 17*





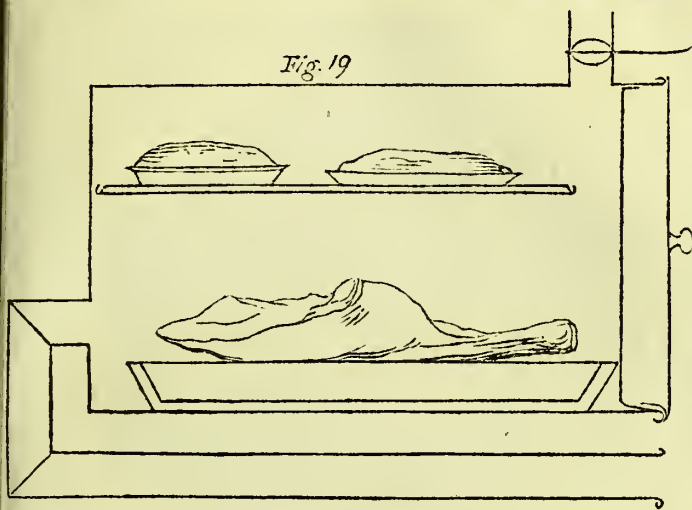


*Fig. 18.*

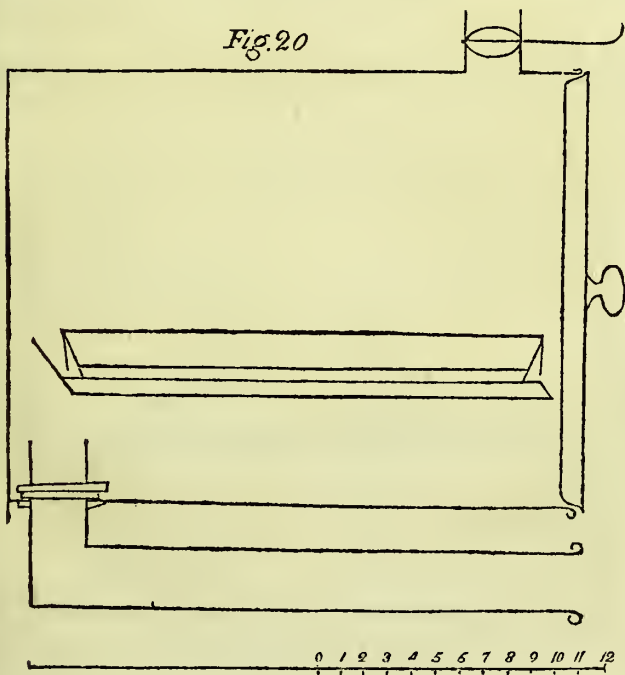


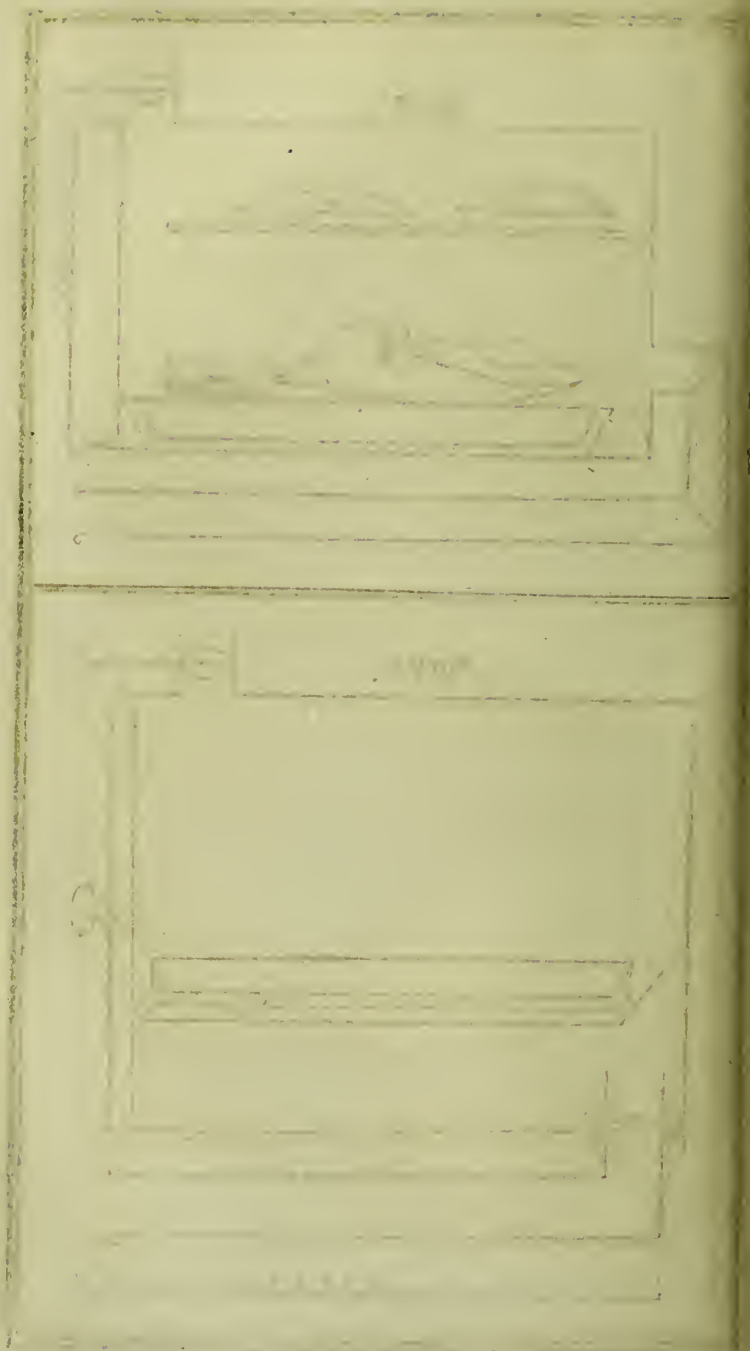


*Fig. 19*



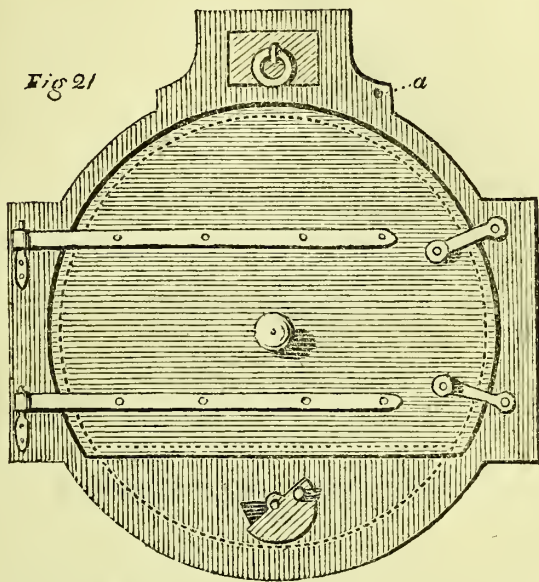
*Fig. 20*



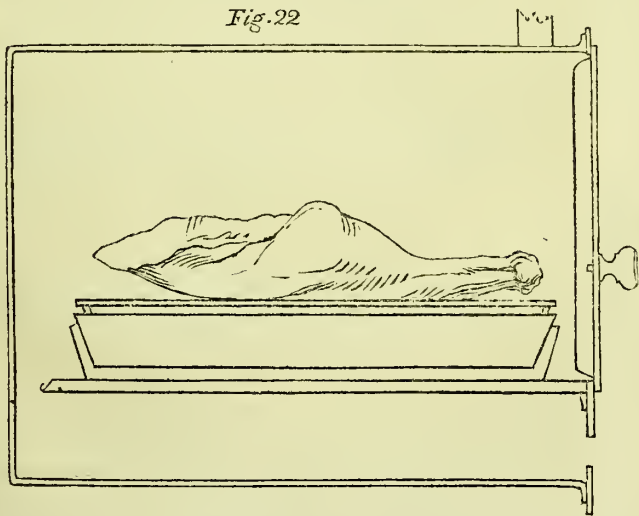




*Fig 21*



*Fig. 22*





## ESSAY X.

PART III.

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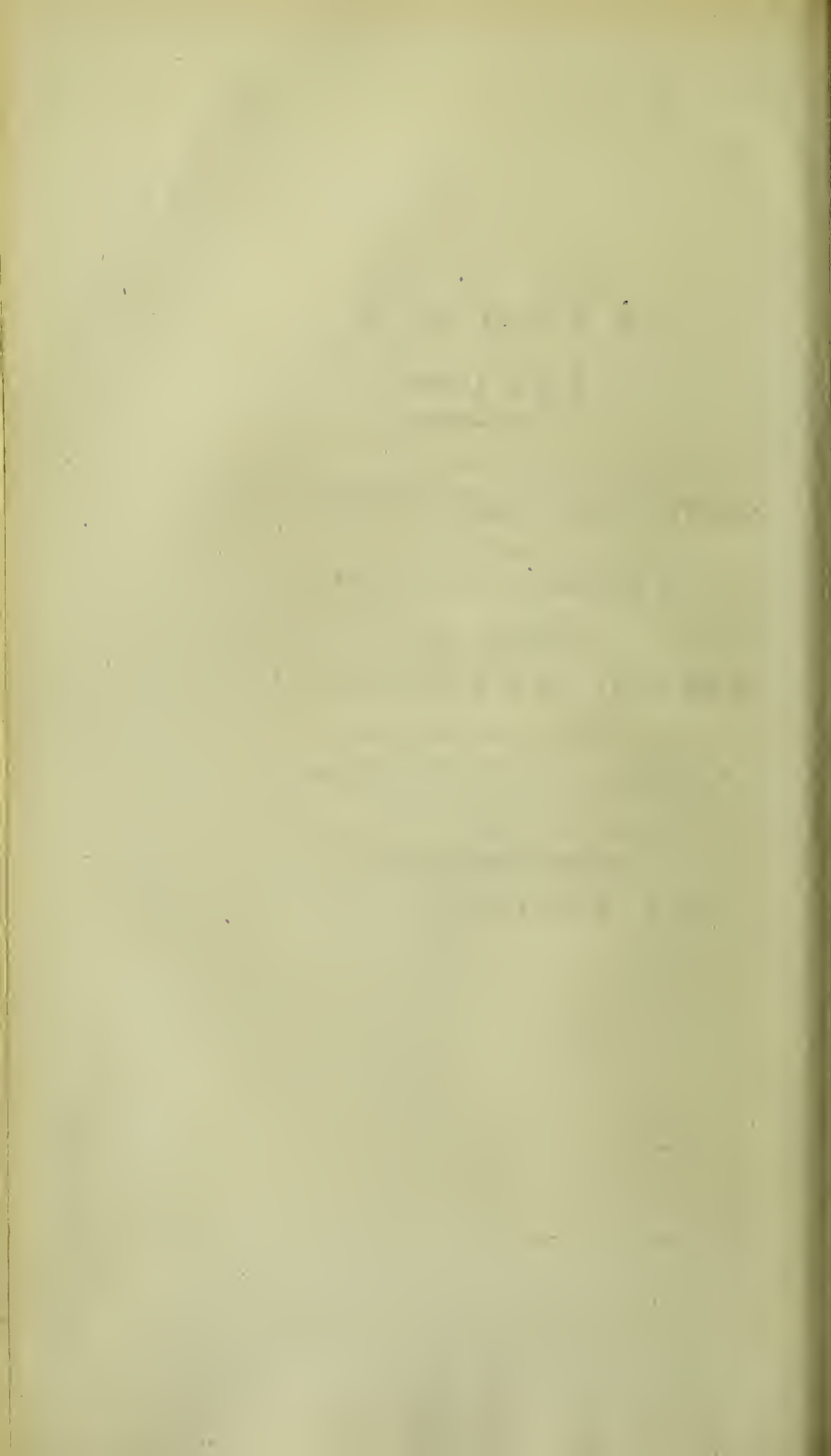
ON THE  
*CONSTRUCTION OF KITCHEN FIRE-PLACES*

AND  
*KITCHEN UTENSILS;*

TOGETHER WITH  
REMARKS AND OBSERVATIONS

RELATING TO THE VARIOUS  
*PROCESSES OF COOKERY;*

AND  
PROPOSALS FOR IMPROVING  
*THAT MOST USEFUL ART.*



## ESSAY X.—PART III.

## CHAP. VII.

*Of the Construction of Boilers, Stew-pans, &c.—Choice of the Material for Constructing Kitchen Utensils—Objections to copper—Iron much less unwholesome—Of the attempts that have been made in different countries to cover the surface of iron boilers with an enamel—Of earthen ware glazed with salt—Stew-pans and sauce-pans of that substance recommended—Kitchen utensils of earthen ware may be covered and protected by an armour of sheet-copper—Wedgewood's ware, unglazed, would answer very well for kitchen utensils—Directions for constructing stew-pans and sauce-pans of copper in such a manner as to make them more durable, and more easy to be kept clean—These utensils are frequently corroded and destroyed by the operation of what has been called the Galvanic influence—Of the Construction of Covers for kitchen boilers, stew-pans, &c.*

**T**HE choice of the material to be used in constructing kitchen boilers, stew-pans, &c. is a matter of so much importance, that I cannot pass it over in silence; though I am very sensible that all I can offer on the subject will not be sufficient



to remove entirely the various difficulties I shall be obliged to point out.

The objects principally to be had in view, in the choice of materials to be used in the construction of kitchen utensils are, wholesomeness—cheapness—and durability. The material most commonly used for constructing kitchen boilers and sauce-pans is *copper*; but the poisonous qualities of that metal, and the facility with which it is corroded and dissolved by the acids which abound in those substances that are used as food, has long been known and lamented; and numerous attempts have been made to prevent its deleterious effects, by covering its surface with tin and with other metallic substances, and with various kinds of varnish and enamel; but none of these contrivances have completely answered the purpose for which they were designed.

The method which has been found to be most effectual is, to keep the copper utensils well tinned, or to tin them afresh as often as the copper begins to appear, and this is what is now commonly practised; but still it were to be wished that some good substitute might be found for that unwholesome metal.

*Iron* has often been proposed; and though it is more liable to be corroded even than copper, yet as the rust (oxide) of iron is not poisonous, though it changes the colour of some kinds of food that are cooked in it, and in some cases communicates

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an astringent taste to them, it is not thought to make food unwholesome.

There is, however, one precaution, by means of which the disagreeable effects produced by this metal on food, that is prepared in utensils constructed of it, may be very much diminished, and indeed in most cases almost entirely prevented, especially when the utensil is made of *cast iron*. If, instead of scouring the inside of iron boilers and stew-pans with sand, and keeping them bright, which notable housewives are apt to do, in order that their kitchen furniture may appear neat and clean, they be simply washed and rinsed out with warm water, and wiped with a soft dish-cloth or towel, the surface of the metal will soon become covered with a thin crust or coating of a dark brown colour, resembling enamel; which covering, if it be suffered to remain, and to consolidate, will at last become so hard as to take a very good polish, and will serve very efficaciously to defend the surface of the metal from farther corrosion, and consequently to prevent the food from acquiring that taste and colour which iron is apt to impart to it.

The process by which this covering is gradually formed, is similar to that by which some gunsmiths brown the barrels of fowling-pieces, and could no doubt be greatly expedited by the same means which they employ for that purpose: the object had in view is likewise the same in both cases, namely, by causing a hard and impenetrable

covering of rust to be formed on the surface of the iron, to defend it from a contact with those substances which are capable of dissolving or corroding it, or in other words, to prevent the farther progress of the rust.

For iron utensils designed merely for *frying*, or cooking in fat, there is an easy and a very effectual precaution that may be taken for preventing rust. It is to avoid putting hot-water into them, and above all to avoid boiling, or even heating water in them. They may occasionally be washed out with warm water; but as often as this is done, great care must be taken to wipe them perfectly dry with a dry cloth before they are put away.

The effects produced by this management may be explained in a satisfactory manner. As fatty or oily substances cannot communicate oxygen to iron, (with which that metal must unite in order that rust may be formed,) and as they prevent the approach of other substances which could furnish it (air, water, acids, &c.) as long as the surface of the iron is completely covered by them, it is evident that no rust can be formed. But boiling hot-water, and more especially water heated and actually made to boil in such a vessel, could not fail to dislodge the fat from the surface of the metal, and leave it naked and exposed to every thing that is capable of corroding it.

Kitchen utensils made of iron may be tinned on the inside to preserve them from rust; and this is frequently done.—But even tin, though it be much  
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less liable to be dissolved by those substances which are used in cookery than iron or copper, yet it is sometimes sensibly corroded by them, and consequently is taken into the stomach with our food.

What its effects may be on the human body, when taken in very small quantities, I cannot pretend to determine.—In large doses it is well known to be a fatal poison.

That the tin with which the insides of kitchen-boilers and stew-pans are covered, is actually corroded in many of the processes of cookery, is rendered highly probable by the very short time that such a coating lasts, when the utensil is in daily use; but I had, not long since, a still more striking proof of that fact. Learning by accident from my cook, that a dish of which I am very fond, (*stewed pears*, which I frequently eat with bread and milk for my supper,) require three hours boiling, it occurred to me, that as this process was performed in a copper stew-pan, tinned, and as it lasted so long a time, the tin might perhaps be attacked, and some part of it dissolved by the acid of the pears, or by that of the sugar which was mixed with them. In order that I might be able to enjoy my favourite dish, free from all apprehensions of being poisoned, I ordered it to be always prepared in future in a stew-pan of porcelain: but several of these vessels having been destroyed in a short time by the fire, in this process, I found myself obliged to abandon this scheme on account of these fre-



quent accidents : and I now had recourse to my Roaster.

The pears, being previously cut in quarters, and freed from their skins, seeds, and cores, were put with a sufficient quantity of water and sugar, into a shallow glass basin fitted with a glass cover, and this basin being placed upon a brick, was put into the Roaster, and a small fire being made under it, the water in the basin was soon brought to boil, and in less than three hours the pears were found to be sufficiently done.

When they were served up, I observed that their colour was different from what it had always been before ; and enquiring into the cause of it, I was let into a secret which explained the matter completely. The cook informed me, that it was absolutely impossible to give *a beautiful red colour* to stewed pears without some metal, and that their colour would not have been so fine as it was when they were cooked in porcelain, had not the precaution been taken *to boil a pewter spoon with them*. The Reader can easily imagine how much I was surprized at receiving this unexpected information.

This ingenious contrivance is similar to one sometimes used in this country—that of boiling *half-pence* with greens to give them a fine colour.

Several years ago a variety of attempts were made in Sweden to improve cooking utensils made of iron, by covering them on the inside with a kind of enamel, to protect them from rust ; and  
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since that time a considerable manufacture of cast-iron boilers and stew-pans, covered within with white enamel, was established by Count Heinitz, on his estate in Silesia; but this scheme has not succeeded intirely, owing to the difficulty of finding an enamel capable of uniting with iron, the expansion of which with heat shall be so nearly equal to the expansion of iron, as not be liable to crack and fly off upon being suddenly exposed to heat and to cold; and even were it possible to compose an enamel that would withstand the effects of the heat and the cold, and the blows to which it would be exposed in the business of the kitchen, there would still remain a very important point to be ascertained, which is, whether the matter of which the enamel is composed *is not itself of a poisonous nature*, and whether there is not reason to apprehend that it might communicate its deleterious qualities to the food?

Lead is an essential ingredient in most, if not all enamels, and as its effects are known to be extremely pernicious to health, under all its various forms, when taken internally, it would be highly necessary to ascertain, by the most rigid experimental investigation, whether the enamel of kitchen utensils contains any lead, or other noxious metals or unwholesome substance; and if this be the case, whether such poisonous substance be liable to be corroded and dissolved, or mixed in any other manner with the food.

It

It is poffible that a poifonous fubftance may be fo fixed, on being mixed and united with other fubftances, as to render it perfectly infoluble, and confequently perfectly inert and harmlefs; but ftill the fact ought to be well afcertained before it is admitted.

A large proportion of the calx of lead enters into the compofition of flint glafs, yet it is not probable that flint glafs ever communicates any thing poifonous to food or drink that is kept in it. But on the other hand there is reafon to conclude, that the glazing of common pottery, which is likewise compofed in part of calx of lead, is not equally fafe, when earthen veffels covered with it are ufed as implements of cookery.—In fome countries the ufe of fuch veffels in the proceffes of boiling and ftewing is forbidden by the laws, under fevere penalties; and in this country it is not customary to ufe earthen veffels, fo glazed, for preferving pickles, and other fubftances defigned for the ufe of the table, which contain ftrong acids.

The beft glazing for earthen veffels that are to be ufed in preparing or preferving food, is moft undoubtedly made with common falt; as this glazing (which appears to be merely the beginning of a vitrification of the earth at the furface of the veffel) is not only very hard and durable, but it is alfo perfectly infoluble in all the acids and other fubftances in common ufe in kitchens; and contains nothing poifonous or unwholefome.

A large proportion of lead enters into the composition of pewter; but it has lately been proved by many ingenious experiments made to ascertain the fact, that the lead, united to tin, and the other metallic substances that are used in composing pewter, is incomparably less liable to be dissolved by acids, and consequently much less unwholesome, than when it is pure or unmixed with other metals. This fact is very important, as it tends to remove all apprehension respecting the unwholesomeness of a very useful compound metal, which from its cheapness, as well as on account of its durability, renders it peculiarly well adapted for many domestic uses. It would not however be adviseable to boil or stew any kind of food, especially such as contain acids, in pewter vessels; nor should acid substances ever be suffered to remain long in them.

The best, or at least the most wholesome material for stew-pans and sauce-pans is, undoubtedly, earthen ware, glazed with salt\*. Several manufacturing

\* Nothing is more pernicious than the glazing of common coarse earthen ware. There is no objection to *unglazed* earthen ware, but its being apt to imbibe moisture, which renders it difficult to be kept clean. I have lately seen some kitchen utensils of very fine, compact, unglazed earthen ware, bought at Mr. Wedgewood's manufactory, which I thought very good. They were made thin, and seemed to stand the fire very well; and as their surface was very smooth, they were easily kept clean. I wish that the intelligent gentlemen, who direct that noble manufactory, would turn their attention to the improvement

factories of this kind of pottery have lately been established in this country, and one in particular in the King's Road, at Chelsea, which belonged to the late Mrs. Hempel, which is, I believe, now carried on by her sons. The principal reason why this article has not long since found its way into common use, is, no doubt, the brittleness of earthen ware, and its being so liable to crack on being suddenly exposed to heat, or to cold; for, excepting this imperfection, it has every thing to recommend it. It is perfectly wholesome (when glazed with salt); and is kept clean with little trouble; and things cooked in it are much less liable to be burnt to the sides of the vessel, and spoilt, than when the utensil is formed of a metallic substance.

There is a very great difference in earthen ware, in respect to its power of withstanding the heat, without injury, on being suddenly exposed to the action of a fire; some kinds of it being much less liable to crack, and fly, when so exposed, than others; and in order to take measures with certainty for diminishing this imperfection, we have only to consider the causes from which it proceeds. Now, it is quite certain, that the cracking of an earthen vessel on its being put over a fire, is owing to *two* circumstances—the brittleness of the substance

ment of an article so nearly connected with the health, comfort, and peace of mind, of a great portion of society. Stew-pans of this material, suspended in a cylindrical armour of sheet iron, would be admirably calculated for the register stoves I shall recommend. Some of these stoves may be seen in the Great Kitchen of the Royal Institution.



stance—and the difficulty or slowness with which heat passes through it; for it is evident, that neither of these circumstances, alone, or acting singly, would be capable of producing the effect.

As heat expands all solid bodies, if one side of a vessel, composed of a brittle substance, be suddenly heated, and *expanded*, it must crack, or rather, it must cause the other surface to crack, unless the heat can make its way through the solid substance of the vessel, and heat and expand that other surface so expeditiously as to prevent that accident. Now as heat passes *through* a vessel which is thin, sooner than through one (composed of the same material) which is thicker, it is evident that the *thinner* an earthen vessel for cooking is made, the less liable will it be to receive injury on being exposed to sudden heat or cold.

I mention sudden *cold* as being dangerous, and it is easy to see why it must be equally so with sudden heat. If a brittle vessel be (by slow degrees) made very hot, if the heat be equally distributed throughout the whole of its substance, this heat, however intense it may be, will have no tendency whatever to cause the vessel to crack; for the expansion being equal at the two opposite surfaces, the *tension* at those surfaces will be equal also; but if cold water be suddenly poured into a vessel so heated, its internal surface will be suddenly cooled, and as suddenly *contracted*; and as the external surface cannot contract, being forcibly kept in a state of expansion by the heat,  
the



the inside surface must necessarily crack, in consequence of its contraction, and this fracture will make its way immediately through the whole solid substance of the vessel from the inside to the outside surface.

Sudden HEAT applied to one side, or surface, of a brittle vessel causes the *opposite* side of it to crack; but sudden COLD causes the *side to crack to which the cold is applied*.

By forming distinct ideas of what happens in these two cases, every thing relative to the subject under consideration will be rendered perfectly clear and intelligible.

The *form* of a vessel has a considerable effect in rendering it more or less liable to be cracked and destroyed by sudden heat or cold. All flat surfaces, sharp corners, and inequalities of thickness, should, as much as possible, be avoided. The globular form is the best of all, and next to it are those forms which approach nearest to it; and the thinner the utensil is made, consistent with the requisite strength to resist occasional blows, the better it will be in all respects.

The best composition for earthen ware for culinary purposes is, I am told, pounded Hessian crucibles, or any kind of broken earthen ware of that kind, reduced to powder, and mixed with a very small proportion of Stourbridge clay.

The method of glazing this ware with salt is by throwing decrepitated common salt into the top of the kiln, with an iron ladle, through six or eight  
holes

holes made for that purpose in different parts of the top of the kiln. These holes, which need not be more than four inches in diameter, each, may be kept covered with common bricks laid over them.

The salt should not be thrown in till the ware is sufficiently burnt, and till it has acquired the most intense heat that can be given it; and the holes should be immediately closed as soon as the salt is thrown in. If as much as a large handful of salt be thrown into each hole, that will be sufficient, unless the kiln be very large.

The salt is immediately reduced to vapour by the intense heat, and this vapour expands itself, and fills every part of the kiln, and disposes the ware to vitrify at its surface.

I have made several attempts to protect stew-pans and sauce-pans of earthen ware from danger from sudden heat, and from accidental blows, by covering them on the outside with sheet-copper, and with sheet-iron, and in these attempts I have succeeded tolerably well. Several stew-pans covered in this manner may be seen in the kitchen, and in the repository of the Royal Institution. As the subject is of infinite importance to the health and comfort of mankind, I wish that some ingenious and enterprising tradesman would turn his attention to it.

As cooking utensils of tinned iron are incomparably less dangerous to health than those which are made of copper, I have taken considerable pains  
to

to get serviceable stew-pans and sauce-pans made of that material. The great difficulty was to unite durability with cheapness and cleanliness. How far I have succeeded in this attempt will be seen hereafter.

As it is probable the copper stew-pans and sauce-pans will continue to be used, at least for a considerable time to come, notwithstanding the objections which have so often been made to that poisonous metal; I shall proceed to an investigation of the best *forms* for those utensils.

Before I proceed to a consideration of the improvements that may be made in the forms of kitchen utensils, I must bespeak the patience of the reader. It is quite impossible to make the subject interesting to those who read merely for amusement; and such would do well to pass over the remainder of this chapter without giving it a perusal; but I dare not treat any part of a subject lightly, which I have promised to investigate. Besides this, I really think the details, in which I am now about to engage, of no inconsiderable degree of importance; and many other persons will, no doubt, be of the same opinion respecting them. The smallest real improvement of any utensil in general and daily use, must be productive of advantages that are incalculable. It is probable that more than a million of kitchen-boilers and stew-pans are in use every day, in the United Kingdom of Great Britain and Ireland; and the providing and keeping kitchen furniture in repair is a heavy article of expence in  
house-

housekeeping. I am certain that this expence may be considerably lessened; and in doing this, that kitchen utensils may be made much more convenient, neat, and elegant, than they now are.

As it is indispensably necessary, in recommending new mechanical improvements, not only to point out what alterations ought to be made, but also to show distinctly *how the work to be done, can be executed in the easiest, and best manner*; the fear of being by some thought prolix and tiresome, must not deter me from being very particular and minute in my descriptions and instructions.

In justice it ought always to be remembered, that my object in writing is, professedly to be useful; and that I lay no claim to the applause of those delicate and severe judges of literary composition, who read more with a view to being pleased by fine writing, than to acquire information. If those who are quick of apprehension are sometimes tempted to find fault with me for being too particular, they must remember, that it is not given to all to be quick of apprehension;—and that it is amiable to have patience, and to be indulgent.—But to proceed.

As the fire employed in heating stew-pans, sauce-pans, &c. may be applied in a variety of different ways; and as the form of the utensil ought in all cases to be adapted to the form of the fire-place, and to the mode of applying the heat, it is necessary, in laying down rules for the construction of stew-pans and kitchen boilers, to take into considera-



tion the construction of the fire-places, in which they are to be used. But kitchen fire-places, constructed on the best principles, are susceptible of a variety of different forms,

In the spacious dwellings of the rich, where large rooms are set apart for the sole purpose of cooking, a number of separate fire-places, in large masses of brick-work, constructed on the principles adopted in the kitchen of Baron de Lerchenfeld, at Munich, will be found most convenient; (see page 39, Part I. of this Essay\*); but for persons of moderate fortunes, to whom the economy of house-room is an object of importance, a less expensive arrangement may be chosen.

It is very easy (as will be shewn hereafter) so to arrange the implements necessary in cooking for a moderate family, as to leave the kitchen, not merely an habitable, but also a perfectly comfortable, and even an elegant room. All those who have seen the kitchen in my house, at Brompton,

\* For all such fire-places, at least for all such as are destined for heating stew-pans and sauce-pans, I am quite sure that *wood* is the cheapest fuel that can be used, even here in London, where it bears so high a price. It is certainly the most cleanly, and most convenient, and makes the most manageable fire. I found by an experiment, made on purpose to ascertain the fact, that any given quantity of wood, burnt in a closed fire-place, gives very near *three times* as much heat as it would give if it were first reduced to charcoal, and then burnt in the same fire-place. But the great advantage of using wood as fuel in the small fire-places of stew-pans and sauce-pans, is, the facility with which it may be kindled, and the facility and quickness with which the fire may be put out (by shutting the dampers) when it is no longer wanted.



ton, (which was fitted up principally with a view to exemplify that important fact) will not doubt the truth of this assertion.

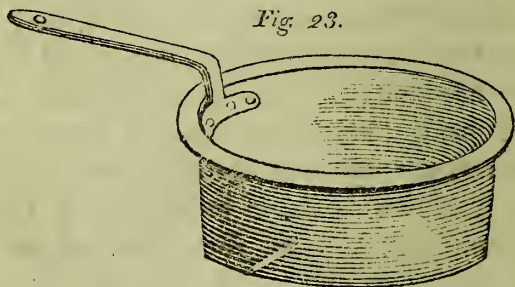
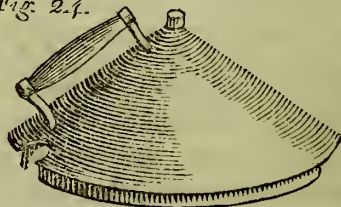
In treating the subject I have proposed to investigate in this chapter, I shall first consider what forms will be best for sauce-pans and stew-pans that are designed to be used in fixed fire-places; and shall then shew how those should be constructed, which are designed to be heated in a different manner.

*Of the Construction of Sauce-pans and Stew-pans for fixed Fire-places.*

The reasons have already been given why stew-pans and sauce-pans ought always to be circular. They are indeed always made in that form; but still, as they are commonly constructed, they have a fault which renders them but ill adapted for the closed fire-places I have recommended. Their handles being fastened to them on their outsides (by rivets) the regularity of their form is destroyed, and they cannot be made to fit well to the circular openings in their fire-places, which they ought to occupy, and to fill.

There are two ways in which this imperfection may be remedied; the first, which is the least expensive, but which is also at the same time the least perfect, is to rivet the handle to the *inside* of the sauce-pan: This leaves the *outside* of the sauce-pan circular, or cylindrical, that is to say, if care is taken to beat down the heads of the rivetting nails,

and to make them flat and even with the outside surface of the vessel; but the regularity of the form of the inside of the sauce-pan will in this case be spoiled by that part of the handle that enters the sauce-pan; which circumstance will not only render it more difficult to keep the sauce-pan clean; but will also make it impossible to close it well with a circular cover. The cover may indeed be so contrived as to fit the opening of the sauce-pan, by making a notch in one side of it to receive that part of the handle which is in the way; and in this manner I have sometimes caused kitchen utensils already on hand to be altered and made to serve very well for closed fire-places. The Figures 23 and 24 will give a perfect idea of the manner in which these alterations were executed.

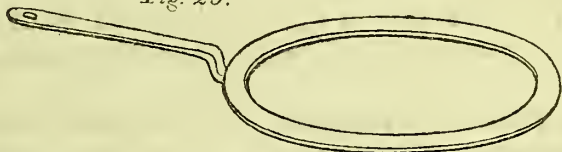
*Fig. 23.**Fig. 24.*

But

But, when new sauce-pans and stew-pans are constructed, I would strongly recommend the following more simple and more advantageous contrivance :

A circular rim of iron should be provided for each sauce-pan, with a handle belonging to it, of the form here represented :

*Fig. 25.*



and by forming the sauce-pan to this rim, its form at its brim will be circular *within* and *without* ; and consequently the sauce-pan will exactly fit the circular opening of its fire-place, and will at the same time be exactly fitted by its *circular cover*. No attention will in that case be necessary, in putting on the cover, to place it in any particular manner or situation,—and the sauce-pan, not being pierced with holes for rivets, will, on that account, be less liable to leak, and will also be more durable, and more easily kept clean\*.

The

\* One reason is obvious why stew-pans without rivets should be more durable than those which have their handles rivetted to them ; but there is another reason more occult, which requires the knowledge of a late discovery in chemistry, to understand. When iron and copper, in contact with each other, are placed in a situation in which they are exposed to be frequently wetted, they act on each other, very powerfully, and one of the

The circular iron rim above recommended should be broad and flat; from  $\frac{2}{16}$  to  $\frac{3}{16}$  of an inch in thickness, and from  $\frac{1}{2}$  an inch to  $\frac{3}{4}$  of an inch in width. Its handle, which must be welded fast to it, and must project from one side of it, may be from  $1\frac{1}{4}$  inch to  $1\frac{1}{2}$  in width, from 6 to 8 or 10 inches long, and of the same thickness as the circular rim, where it joins it.

The under side of this flat iron rim should be made perfectly flat, in order that the sauce-pan,

metals will soon be destroyed by rust. When ships first began to be covered with copper this fact was not known, and great inconvenience was found to arise from the rapid decay of the iron bolts in the vessels so covered. As there appeared to be no remedy for this evil, it was found necessary to substitute copper bolts for iron bolts, in constructing ships intended to be coppered. These effects are now known to depend on what (from the name of its discoverer) has been called the *Galvanic influence*.

It appears to me to be highly probable that stew-pans and sauce-pans, constructed in the manner above described, would last more than twice as long as those made in the usual manner. Frequent attempts have been made to line copper boilers and sauce-pans with tinned iron (commonly called sheet-tin) in order to guard against the poisonous qualities of the copper; but none of these have succeeded so well as was expected; the tin being found to be destroyed by rust with uncommon rapidity. This, no doubt, was owing to the influence of the same cause by which the iron bolts of coppered ships were so suddenly destroyed.

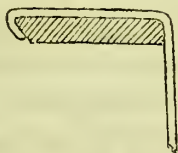
If handles must be riveted to the sides of copper sauce-pans or boilers, such handles should be made of copper, and not of iron; and the nails by which they are fastened, should likewise be copper. They would cost something more, at first, but the utensils would last so much longer, that they would turn out to be much the cheapest in the end.



by being suspended by it in its fire-place, may so completely close the circular opening of the fire-place, as to prevent the smoke from coming into the room; and also to prevent (what would be much more likely to happen)—the cold air of the room from descending into the fire-place, and mixing *there* with the flame and smoke, and afterwards going off, thus heated, through the chimney, into the atmosphere.

The copper sauce-pan or stew-pan is to be fastened to its iron rim by being turned over its outward edge; and in order that the copper, thus turned over the outward edge of the iron rim, may hold fast without projecting below the level of the lower flat surface of the ring (which would be attended with inconvenience), the lower part of the outward edge of the ring must be chamfered away, in the manner represented in the following figure (26), which shews a vertical section of the ring, of the full size, with the copper turned over it.

*Fig. 26.*



The upper inside edge of this iron ring may be rounded off, as it is represented to be in the above figure. In this figure the section of the ring is distinguished by diagonal lines; and that of the



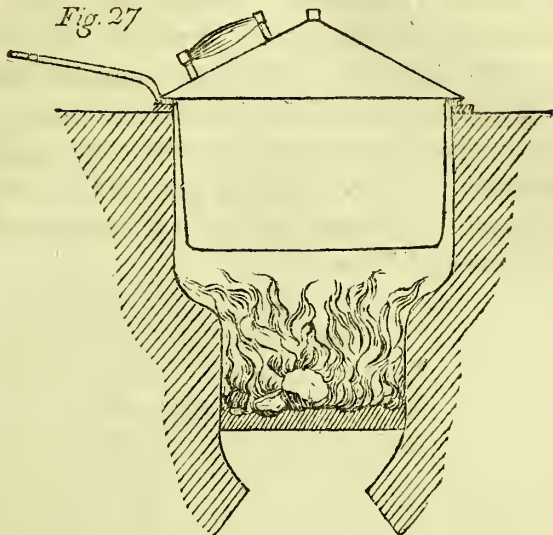
copper, (which is turned over it), by two parallel crooked lines.

When stew-pans and sauce-pans are constructed on the principles here recommended (with flat circular iron rings), an advantage will be attained, which in many cases will be found to be of no small importance: they will be well adapted for being used in small portable fire-places, heated by charcoal; or in portable stoves, heated (or rather kept hot) by heaters. Descriptions of these portable fire-places and heater-stoves will be given in the sequel of this work.

As the upper part of the circular opening of the fire-place (Fig. 27.) on the top of which the lower part of the circular rim of the sauce-pan reposes, is nearly on a level with the top of the solid mass of the brick-work, it is necessary that the handle of the sauce-pan should be bended upwards, so as to be above the level of the brim of the sauce-pan; otherwise, when the sauce-pan is in its place, there would not be room between the handle and the surface of the brick-work for the fingers to pass in taking hold of the handle to remove the sauce-pan. This is evident from a bare inspection of the following figure (27); which represents the section of a sauce-pan constructed on the plan here proposed, fitted into its fire-place.

There

Fig. 27



There should be a round hole, about a  $\frac{1}{4}$  of an inch in diameter, near the end of the handle, by which the sauce-pan may occasionally be hung up on a nail, or peg, when it is not in use. The cover belonging to the sauce-pan may be hung up on the same nail, or peg, by means of the projection of its rim.

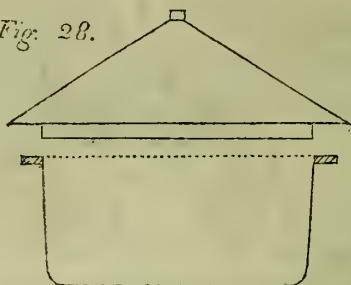
These will be thought trifling matters; but it must not be forgotten that convenience, and the economy of time, are often the result of attention to the arrangement of things apparently of little importance.

In constructing *the cover of a sauce-pan*, care must be taken to avoid a fault, into which it is easy to fall, and which, as I have found by experience, will be attended with disagreeable consequences.

sequences. The circular plate of tin, or of thin sheet-copper tinned, which forms the bottom of the cover, should be of the same diameter *precisely* as the outside of the brim of the sauce-pan.

I once thought it would be better to make the bottom of the cover rather *larger* than the top of the brim of the sauce-pan, as it is represented in the following section.

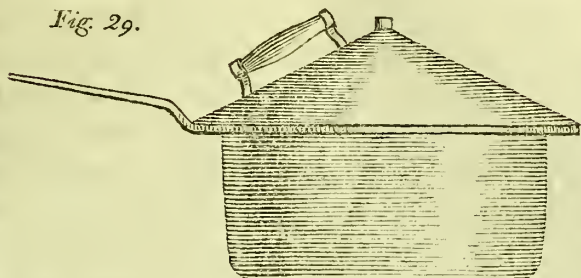
*Fig. 28.*



I imagined that it would prevent any thing that happened by accident to be spilled on the cover, from finding its way into the sauce-pan, and spoiling the victuals; and this indeed it would do most effectually; but it often occasioned another accident not less disagreeable in its effects; it drew the smoke into the sauce-pan, which happened to escape by the sides of the circular opening of the fire-place.

When the cover is precisely of the same diameter as the brim of the sauce-pan, there is little danger of any thing entering the sauce-pan in this manner, as will be evident from an inspection of the following figure.

*Fig. 29.*



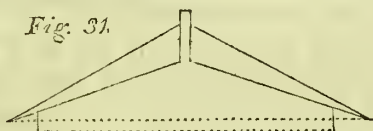
The bottom of the cover may either be made quite flat, as in this section :

*Fig. 30.*



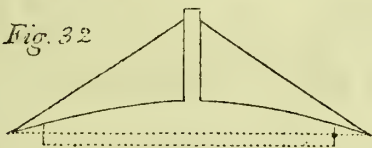
Or it may be made concave, and of a conical form, thus :

*Fig. 31.*



Or concave, and of a spherical figure, as is represented in the following figure :

*Fig. 32*



The only utility derived from making the bottom of the cover hollow, instead of flat, is, that a little more room is left for the boiling up, or swelling of the contents of the sauce-pan. Cooks will be best able to judge how far this is an object of importance.

In

In each of the three last figures, a section of the tube which carries off the steam is shewn, as also a section of the rim of the cover that enters the sauce-pan. This rim, which may be from  $\frac{3}{4}$  of an inch to 1 inch in breadth, should be made to fit the opening of the sauce-pan with some degree of nicety; but it should not be fitted so closely as to require any effort in removing it, or so as to render it necessary to use both hands in doing it—one to hold the sauce-pan fast in its place, and the other to take off its cover.

The steam tube of the cover, which may be  $\frac{1}{2}$  an inch or  $\frac{1}{3}$  of an inch in diameter, and should project about  $\frac{1}{2}$  an inch above the top of the cover, must pass through both the top and the bottom of the cover, and must be well fitted and foldered in both, in order that the air between the top of the cover and its bottom may be confined and completely cut off from all communication with the steam, and also with the external air. This steam tube should have a fit stopple, which may be made of wood, and which, to prevent its being lost, should be attached to the top of the cover, by a small wire chain, about 2 or 3 inches long.

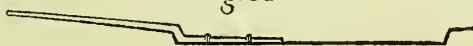
In respect to the handles of these covers, the choice of the form to be adopted may be left to the workman who is employed to make the cover; for, excepting in certain cases, which will be particularly noticed hereafter, it is a point of little importance.



It is right that I should observe here, that though the covers I have here described are such as I have generally recommended, yet others of different forms may be constructed on the same principles that very possibly may answer quite as well as these, and cost less. The steam tube, for instance, for small sauce-pans, may with safety be omitted, and the steam be left to make its way between the rim of the cover and the sauce-pan; and should it be thought an improvement, the upper part of the cover, instead of being a cone, may be a segment of a sphere.

The following figure is the section of the cover of a sauce-pan, now in general use in this country.

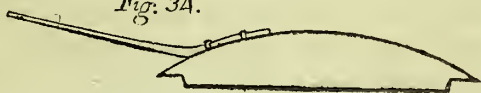
*Fig. 33*



It is made of a circular piece of sheet copper, and its handle, which is of iron, is fastened to it by rivets; and it is tinned on the under side. Its form is such that it fits without a rim into the sauce-pan to which it belongs.

This cover might be greatly improved, and perhaps rendered as well adapted for confining heat as any metal cover whatever, merely by covering it above with a thin circular plate of tinned iron, or of copper, either quite flat, or convex, like that represented by this figure.

*Fig. 34.*



It

It can hardly be necessary for me to observe, that this thin circular plate must be well soldered to the cover, all round its circumference, in order to confine the air that is intercepted between the upper surface of the cover and the lower surface of this plate.

For the mere purpose of confining the heat in a stew-pan or small boiler—were superior neatness and cleanliness not objects of particular attention—one of the very best covers that could be used would be a common sauce-pan cover, defended above from the cold air of the atmosphere by a circular cover of wood, firmly fixed to it by means of a screw, or a rivet.

The following Figures

*Fig. 35.*



*Fig. 36.*



*Fig. 37.*



represent covers so defended; and were the circular piece of wood, to prevent its warping, to be composed of two or three very thin boards, glued fast to each other, and nailed or rivetted together, to unite them more strongly, I am inclined to think that this would be one of the best covers for common use, especially for large stew-pans, that could be made. Its handle might be made of wood, and of either of the forms represented in these figures, or of any other simple form.

The

The covers for large stew-pans should always be furnished with steam tubes, in order that the steam, when it becomes too strong to be confined, may escape without deranging or lifting up the cover.

A cover made entirely of wood might answer very well for confining heat, especially if care were taken to construct it in such a manner as to prevent its being liable to be warped by the heat, and by the moisture, to which it is continually exposed; but the wooden covers of boilers, sauce-pans, and stew-pans, require much attention to keep them clean, unless they be lined with tin, or with sheet-copper.

Having now finished my observations on the covers of small boilers and sauce-pans, *in their most simple state*; when they are designed merely for confining heat; it remains to consider of the means that may be put in practice to render them useful in *directing* the heat that escapes in the steam, which is formed when liquids are boiled, in the various processes of cookery, and *employing this heat to useful purposes*.

As the quantity of heat that exists in steam is very considerable (as has been elsewhere observed) the recovery of this heat is frequently an object deserving of attention; but before we proceed in this enquiry, it will be necessary to say something respecting the method of *Cooking in Steam*. This subject will be treated in the following chapter.

## CHAPTER VIII.

*Of Cooking in Steam—Objections to the steam-kitchens now in use—Principles on which a steam apparatus for cooking should be constructed—Descriptions of fixed boilers for cooking with steam—A particular description of a STEAM-RIM for boilers, by means of which their covers may be made steam-tight—Description of a STEAM-DISH, to be used occasionally for cooking with steam over a kitchen boiler—Account of what has been called a FAMILY-BOILER; many of them have already been sold, and have been found very useful—Hints to Cooks, concerning the means that may be used for improving some popular dishes.*

AS the art of cooking with steam is well known, and has long been successfully practised in this country, it would be a waste of time to attempt to prove, what is universally acknowledged, namely, that almost every kind of food usually prepared for the table in boiling water, may be as well cooked, and in many cases better, by means of boiling-hot steam. I shall therefore confine my present enquiries to the investigation of the best methods of confining and directing steam, and employing it usefully with the most simple and least expensive apparatus.

Steam-kitchens, as they are called, consist of very expensive machinery, and I have been informed

formed by several persons who have used them, that they do not produce any considerable saving of fuel. Bare inspection is indeed sufficient to shew that they cannot be economical in that respect ; for the surface of the tin steam-vessel filled with hot steam, that is exposed quite naked to the cold air of the atmosphere, is so great, that it must necessarily occasion a very considerable loss of heat.

A primary object in contriving a steam apparatus for cooking, should be to prevent the loss of heat *through the sides of the containing vessels* ; and this is to be done, first, by exposing as small a surface as possible to the atmosphere ; and secondly, by covering up that surface with the warmest covering that can conveniently be used, to defend it from the cold air.

The steam-vessel in the kitchen of the Foundling Hospital, is a large wooden box, lined with tin, capable of containing a large quantity of potatoes ; and the steam comes through a small tin tube, from an oblong quadrangular iron boiler, which is used daily for boiling meat, &c. for the Hospital. As this boiler is furnished with what I have called a *steam-rim* (which will presently be described) when the (wooden) cover of the boiler is down, all the steam that is generated in the boiler is forced to pass through the steam-box, and the potatoes, greens, &c. that are in the box are cooked, without any additional expence of fuel.



The steam-box has a steam-rim, and also a wooden cover, which, when it is down, closes the box, and makes it perfectly steam-tight.

When steam is generated faster than it can be condensed in the steam-box, that which is redundant passes off by a waste tube, which conducts it into a neighbouring chimney.

The apparatus for cooking with steam in the kitchen of the House of Correction, at Munich, is still more simple. Here, two equal quadrangular boilers are set, one at the end of the other, at the same level, in the same mass of brick-work, and the flame and smoke from the same fire pass under them both; (see Essay X. Part I. plate iv. fig. 7, and plate v. fig. 9.) Both boilers being inclosed in brick-work, and being covered with wooden covers, it is evident that no part of the apparatus is exposed to the cold air.—I say *no part* of it; for the covers of the boilers being of wood, which is one of the worst conductors of heat, very little heat can make its way through them; and to prevent even this loss, inconsiderable as it is, these wooden covers may, if it should be thought necessary, be defended from the cold air, by warm rugs thrown over them.

The smoke which passes under the second boiler, not only prevents the approach of the cold air to the under surface of its bottom, but, acting on the small quantity of water that is contained in it, actually assists in the generation of steam. It even happens

happens sometimes, (namely, when there is but a small quantity of water in the second boiler, and the first is nearly filled with cold water) that the water in the second boiler actually boils, and fills the boiler with steam, before the water in the first boiler is heated boiling hot.

This appears to me to be one of the most economical methods that can be used for cooking, and that it is well adapted for hospitals, and also for large private families. If it should be necessary to make provision for cooking a great number of different dishes in steam at the same time, either the steam-boiler may be made sufficiently large to receive them; or, instead of it, two or more steam-boilers, of a moderate size, may be put up; and if the different kinds of food that are cooked at the same time in the same steam-boiler, be placed each in a separate dish, and covered over with some proper vessel in the form of a bell (a common earthen pot, for instance, turned upside down) the exhalations from the different kinds of food will be prevented from so mixing together as to give an improper taste or flavour to any of the victuals.

These covers to the different dishes will likewise be useful on another account; when the cover of the steam-boiler is opened, for the purpose of examining, or of introducing or removing any dish, the process of cooking going on in the other dishes will not be interrupted: for their bell-like covers remaining filled with steam, will prevent the cold air from coming into contact with the victuals. It

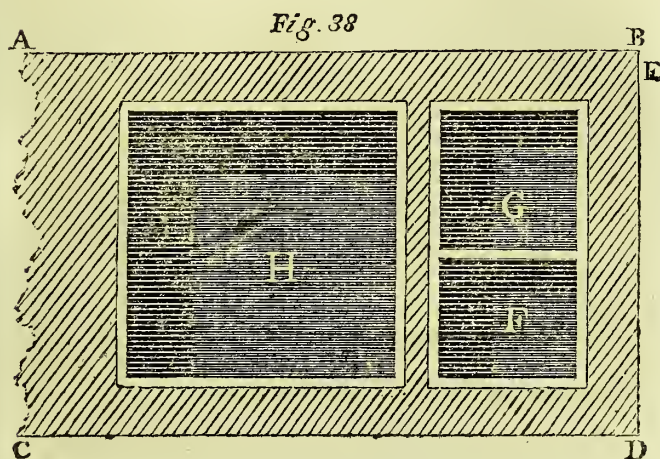
is true, that the cover, or lid, of the steam-boiler must not be kept open too long, otherwise the steam confined under the covers of the dishes will be condensed, and the cold air will find its way under them.

In order that these boilers may be perfectly steam-tight when their lids are down, they must all be furnished with *steam-rims*; and there must be a tube of communication between them for the passage of the steam; and another tube to carry off the redundant steam from the boiler which is situated farthest from the fire.

If it should be necessary, the principal boiler may, without any difficulty or inconvenience, be divided into two compartments, so as to render it possible to prepare two different kinds of soup, or to boil two different things separately, at the same time. Suppose, for instance, that the apparatus is designed for the kitchen of a large family, and that the principal boiler is 12 inches wide, 24 inches long, and 12 inches deep; this may be so divided by a vertical partition, as to form two compartments; the one—that immediately over the fire, for instance, 12 inches by 10; and the other 12 inches by 14. In this case I should make the second, or *steam-boiler*, 24 inches square by 12 inches deep, and should cause the smoke to circulate in three flues, parallel to each other; the first (in the hither end of which the fire-place should be situated) should be immediately under the first boiler; and the second and third should be under the second boiler.

The

The following figure shews the manner in which these boilers should be fet :



A, B, is the side of the room. A, C, D, E, the mass of brick-work in which the boilers are fet.

F, and G, are the two compartments of the first boiler, which is shewn with its steam-rim.

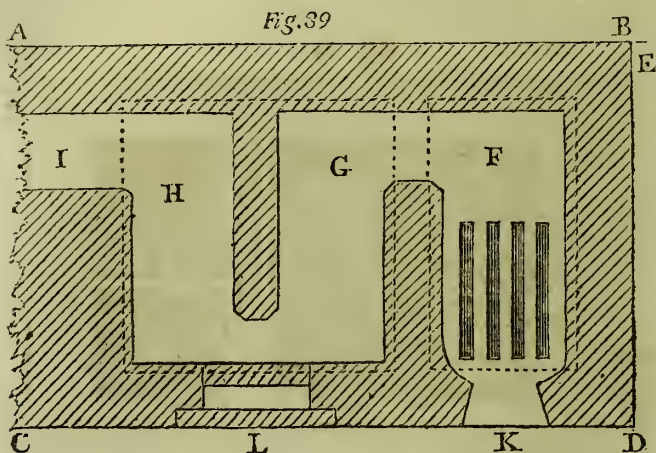
H. is the larger boiler, which is also represented with its steam-rim.

The covers of these boilers (which do not appear in the figure) should be so attached to the boilers by hinges, as to be laid back when the boilers are opened, and rested against the side of the room ; and these covers should be lined with tin, or with thin sheet copper, tinned.

The following figure represents an horizontal  
R. 3
section



section of the brick-work in which these boilers are to be set, taken at the level of the tops of the flues :



A, B, is the side of the room, and A, C, D, E, the mass of brick-work, which is placed against it. F, G, and H, are the three parallel flues, and I. is the canal that carries off the smoke from the second boiler to the chimney. K. is the opening into the fire-place by which the fuel is introduced ; and L. is a passage, closed up with a tile or with loose bricks, which is occasionally opened to clean the flues G, and H.

The damper in the canal I, may be placed near the left-hand side of the second boiler:

The situations of the boilers are indicated by dotted lines.

As it is not necessary that I should repeat in this place the directions which have already been so amply explained concerning the proper method of proceeding

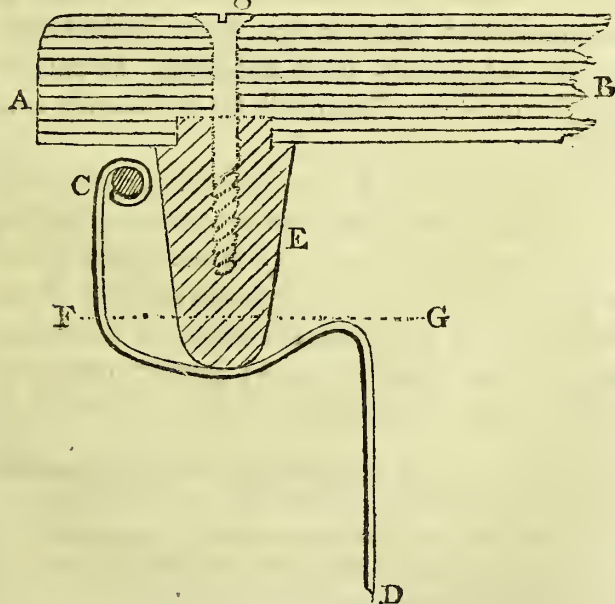


proceeding in setting boilers, I shall not enlarge farther on that subject, but shall proceed to give an account of a very essential part, not yet described, of the apparatus necessary for cooking with steam, in the simple way I have here recommended: the part I mean is the *steam-rim* of the boiler:

*Description of a Steam-rim for a Boiler, by means of which its Cover may easily be made steam-tight.*

To give a more complete idea of this contrivance I have, in the following figure, represented a vertical section of a small part of one side of a boiler, and its steam-rim, with its (wooden) cover in its place, both of the full size:

*Fig. 40*



A. B. is a section of part of the flat wooden cover ;  
the

the crooked line C. D. is a section of the steam-rim, and part of the side of a boiler. E. is a section of a descending rim of wood belonging to, and making an essential part of the cover; which rim, when the cover is down, enters the steam-rim of the boiler, and reposes on the bottom of it. In the figure it is represented in this situation: the wooden rim of the cover is fastened to the flat part of it by means of wood-screws, one of which is represented in the figure\*.

Now it is evident, from an inspection of the figure, that a small quantity of water will lodge in the steam-rim, and will stand at the level of the dotted line F. G; and as the rim of the cover will enter this water when the cover is shut down, all communication between the steam in the boiler, and the external air, must necessarily be cut off, and of course the steam will be completely confined,

It is true that if, in consequence of the increase of its temperature, above the heat of water boiling in the open air, the elasticity of the steam should become sufficient to overcome the pressure of the atmosphere, it will force the water in the steam-rim to ascend toward C. and getting under the rim E. of the cover of the boiler, it will make its

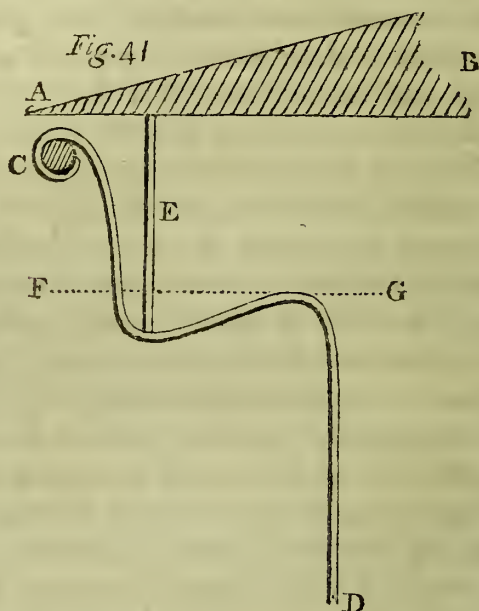
\* The cover itself is supposed to be framed and pannelled in the manner described in the 5th chapter of this Essay (part II.) and it should be lined with tin, or with thin sheet copper, tinned, in order to prevent the wood from being cracked and destroyed by the steam.

escape, but no bad consequences will result from this loss; on the contrary, the steam-rim will, in this case, serve instead of a *safety valve*; and although this contrivance may not be adequate to the confining of *strong* steam, it certainly answers perfectly well for confining that kind of steam which is most proper to be used for cooking. It will likewise be found useful in many cases for covering boilers, where the principal object in view is to prevent the contact of the cold air with the contents of the boiler. It will be useful for the boilers of bleachers, as also for laundry boilers, for brewers boilers, and for all boilers destined for the evaporation of liquids under a boiling heat.

It appears to me that this contrivance might, with a little alteration, be used with great advantage for covering the boilers used by distillers. By making the steam-rim deeper, the cover of the boiler would be tight, under a considerable pressure; and by making the boiler broad and shallow, with several separate fire-places under it (the flat bottom of the boiler being supported on the tops of the flues of these fire-places) a variety of important advantages would be gained; and these would not be compensated by any disadvantages that I can foresee. The boiler might be constructed of very thin sheet copper, which would not only render it less expensive, but would also make it more durable.

When steam-rims were first introduced, they were made of the form represented in the following figure,

figure, which represents a vertical section of part of one side of a boiler with a steam-rim, covered with a conical double cover, made of tin :



In this and the following figures, A, B, represents a section of part of one side of the (double) cover of the boiler.

C. D. The steam-rim and part of one side of the boiler.

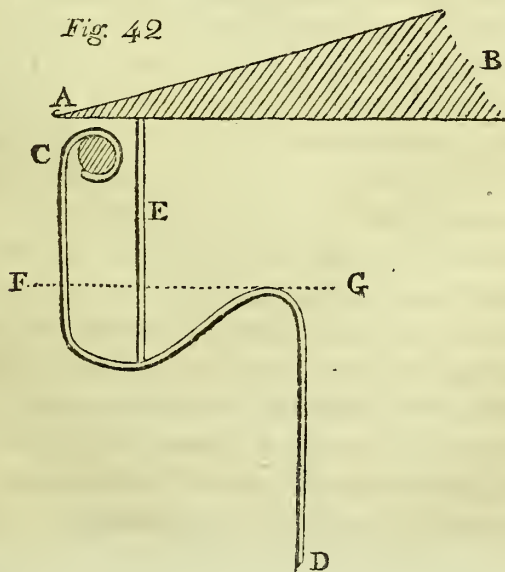
E. The descending rim of the cover : and,

F. G. The level of the water in the steam-rim—all of the full size.

This construction was found to be attended with an inconvenience, which, indeed, might easily have been foreseen. When the steam, on being confined,

finer, became strong enough to force its way under the descending rim E. of the cover of the boiler, the water in the steam-rim was frequently blown out of it with considerable violence, and dispersed about the room. To prevent these disagreeable accidents, the form of the upper part of the steam-rim was altered. To make a proper finish to the boiler, the edge of its brim (which forms the top of its steam-rim) had been turned *outwards* over a strong wire. It was now turned *inwards* over the wire; and the outside, or rising part of the steam-rim, instead of being made *sloping outwards*, was now made *vertical*.

A complete idea of these different alterations, and of the effects necessarily produced by them, may be formed by comparing the foregoing figure (41) with the following:



It



It is evident that in this case, as there is sufficient room between the outside of the descending rim of the cover, and the vertical side of the steam-rim, to contain all the water that can be forced upwards between them by the steam, there is little danger of any part of this water being blown out of the steam-rim by the steam, when it makes its escape under the rim of the cover.

*Of the Manner in which Kitchen Boilers and Stew-pans may be constructed, so as to be rendered useful in cooking with Steam.*

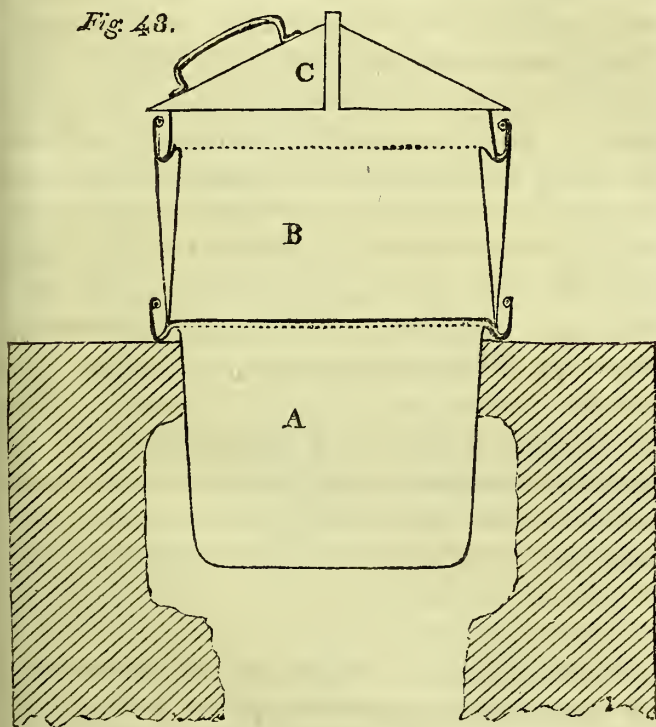
If a common kitchen boiler be furnished with a steam rim, and the descending rim of its cover be made to shut down into it, the steam in the boiler will be effectually confined, and may, in various ways, be usefully employed in cooking. One of the simplest methods of doing this is to set what I shall call a *steam-dish* upon the boiler. The bottom of this steam-dish being furnished with a descending rim, or projection, fitting into the steam-rim of the boiler, the steam-dish may be made to serve as a cover to the boiler; and if a number of small holes be made in the bottom of this dish near its circumference, the steam will pass up into it from below; and if it be properly closed above, any victuals placed in it will be cooked in steam.

If this dish be furnished with a steam-rim, of the same form and size with that of the boiler, the cover of the boiler will then serve for covering the steam-dish, whenever that dish is in use.

The

The following figure, which represents a vertical section of the apparatus, will show this contrivance in a clear and distinct manner :

*Fig. 43.*



A. is the boiler, which is seen set in brick-work.

B. is the steam-dish ; and

C. is the cover of the boiler, which is here made to serve as a cover for the steam-dish.

The sides of the steam-dish (which is made of tin) are double, for the purpose of confining the heat more effectually.

If

If it be required to cook several kinds of food at the same time, a steam-dish may be used that is divided into several compartments ; or two or more steam-dishes may be placed one above another, over the same boiler, that which is uppermost being covered with the cover of the boiler.

A very complete apparatus of this kind may be seen in the kitchen of Mr. Summers, of New Bond-street, ironmonger, who makes and sells these articles, and who has sold no less than 225 sets of these FAMILY BOILERS, as they are called, since he first began to manufacture them ; and Mr. Feetham, of Oxford-street, has sold 110 sets of them. A cooking apparatus of this kind may likewise be seen at the Royal Institution ; and at Herriot's Hospital, at Edinburgh ; and in the houses of many private families, in England and Scotland. There are several tradesmen who now manufacture them, and all persons desirous of making and selling them are at full liberty to do so.

When different kinds of food, placed one above the other, are cooked in steam, the drippings of those above might, in some cases, be apt to spoil those below, if means were not used to prevent it : This inconvenience may be avoided in the apparatus I am describing, by introducing the food into the steam-dishes, placed in deep plates or in shallow basons, sufficiently capacious, however, to contain as much water as will be generated in consequence of the condensation of the steam on the surface of the food in heating it boiling hot. I say,

say, "in heating it boiling hot," for after it is once heated to that temperature, no more steam will be condensed upon it, however long the process of cooking may be continued\*.

This

\* It is not difficult to determine with great precision, what the size or contents of the dish must be, in order that it may contain all the water that can possibly be produced by the condensation of the steam, in heating the victuals that are cooked in it, to the temperature of boiling water. Suppose, for instance, that a piece of beef, weighing six pounds, is to be cooked in the steam-dish, and that this meat, when it is put into the dish, is at the temperature of  $55^{\circ}$  of Fahrenheit's Thermometer, which is the mean annual temperature of the atmosphere at London. Now as this piece of meat is to be made boiling hot, its temperature must be raised 157 degrees, namely from  $55^{\circ}$  to  $212^{\circ}$ . But we have seen that any given quantity, by weight, of beef, requires less heat to heat it any given number of degrees, than an equal weight of water, in the proportion of 74 to 100; (see the introduction to this Essay, page 12) consequently these 6lb. of beef will be heated 157 degrees, or from  $55^{\circ}$  to the boiling point, with a quantity of heat which would be required to heat 4lb. 7 oz. of water 157 degrees.

Now if we suppose, with Mr. Watt, that the steam which produces, in its condensation, 1lb. of water, gives off as much heat as would raise the temperature of  $5\frac{1}{2}$  lb. of water 180 degrees, namely, from the point of freezing to that of boiling water, the same quantity of heat must be sufficient to raise the temperature of 6lb. 5 oz. of water 157 degrees, or from  $55^{\circ}$  to  $212^{\circ}$ .

And if 6lb. 5 oz. of water require 1lb. of condensed steam to heat it 157 degrees, 4lb. 7 oz. of water, or 6lb. of beef, will require only  $11\frac{1}{4}$  oz. of condensed steam to raise its temperature the same number of degrees, for it is 6lb. 5 oz. is to 1lb. as 4lb. 7 oz. to  $11\frac{1}{4}$  oz.

Consequently if 6lb. of beef at the temperature of  $55^{\circ}$  were placed in a steam apparatus, in a shallow dish, capable of containing



This is a curious circumstance, and the knowledge of the fact may be turned to a good account. If, for instance, it were required to make the strongest extract of the pure juices of any kind of meat, unmixed with water; this may be done by heating the meat nearly boiling hot, either in boiling water, or in steam, and then putting it, placed in a shallow dish, into a steam-dish, or into any closed vessel filled with hot steam, and leaving it in this situation two or three hours, or for a longer time: Whatever liquid is found collected in the dish at the end of the process, must necessarily be the purest juices of the meat. In this manner the richest gravies may no doubt be prepared.

Thick steaks or cutlets of beef, boiled in this manner, and made perfectly tender throughout, and then broiled on a gridiron, and served up in their own gravy, with or without additions, would, I imagine, be an excellent dish, and very wholesome: But it must be left to cooks, and to professed judges of good eating to determine, whether these hints, (which are thrown out with all becoming humility and deference) are deserving of attention: For although I have written a whole chapter on the pleasure of eating, I must acknowledge, what

taining  $11\frac{1}{4}$ oz. or a little less than *three quarters of a pint*, this dish would contain all the water that could possibly result from the condensation of steam on the surface of the meat, in heating it boiling hot.

This computation may be of some use in determining the dimensions of the vessels proper to be used for holding the victuals that are cooked in the steam-dishes above described.

all



all my acquaintances will certify—that few persons are less attached to the pleasures of the table, than myself. If, in treating the subject, I sometimes appear to do it *con amore*, this warmth of expression ought, in justice, to be ascribed solely to the sense I entertain of its infinite importance to the health, happiness and innocent enjoyments of mankind.

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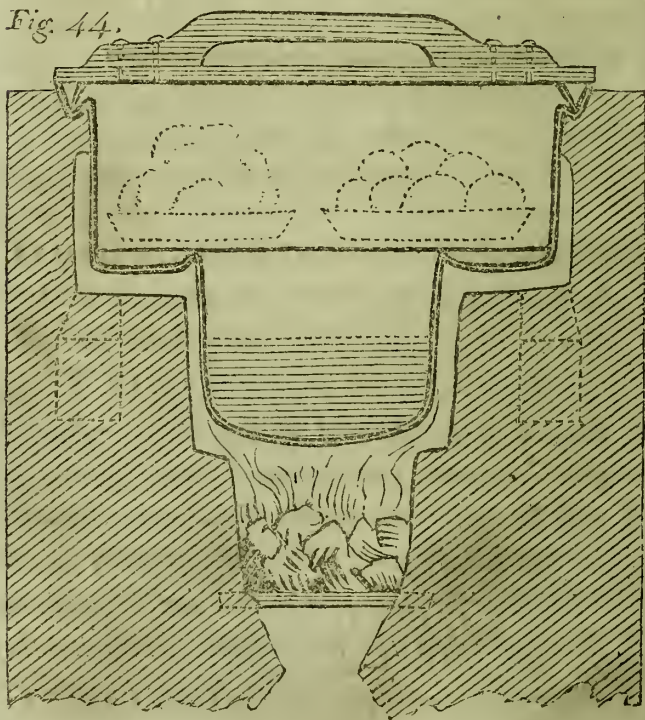
## CHAP. IX.

*Description of an UNIVERSAL KITCHEN BOILER, for the use of a small family, to answer all the purposes of cookery; and also for boiling water for washing, &c.—Description of a PORTABLE FIRE-PLACE for an universal Kitchen Boiler.—Account of a Contrivance for warming a Room by means of this Fire-place and Boiler.—Of STEAM STOVES for warming Rooms.—They are probably the best contrivance for that purpose that can be made use of—they warm the air without spoiling it—they economise Fuel, and may be made very ornamental.*

*Description of an UNIVERSAL KITCHEN BOILER for the use of small Families, to answer all the purposes of cookery; and also for boiling water for washing, &c.*

**T**HE following figure represents a vertical section of this boiler, and also of its fire-place and cover.

*Fig. 44.*



This boiler is supposed to be made of cast-iron, and its section is represented by a double line.

The lower part of it, which is represented as being filled about half full with water, is 12 inches in diameter above, about 11 inches in diameter below, and  $9\frac{1}{2}$  inches deep. The upper part of it, which is furnished with a steam-rim, is 24 inches in diameter above—where its steam-rim begins—and 23 inches in diameter below—where it joins the flat part which unites it to the lower part of the boiler.

The lower part of this boiler (which might, without any impropriety, be called the *lower boiler*) is destined for containing the soup, or the water that is made to boil, while the upper and broader part is used for boiling with steam. The brim of the lower boiler projects upward, about an inch above the level of the flat bottom of the upper boiler. This projection prevents the water resulting from the condensation of steam against the sides of the upper boiler from descending into the lower boiler. The upper boiler is  $8\frac{1}{2}$  inches deep, from the top of the inside of its steam-rim to the flat part of its bottom. The whole depth of both boilers is 18 inches, from the top of the steam-rim to the lower boiler.

A circular piece of tin, about 22 inches in diameter, with many holes through it, to give a free passage to the steam, being laid down, in an horizontal position, upon the top, or projecting brim of the lower boiler. Upon this circular plate the shallow dishes are placed, which contain the victuals that are to be cooked in steam. Two such dishes are faintly represented in the foregoing figure by dotted lines.

The cover of this universal boiler is a shallow circular dish, 26 inches in diameter at its brim, and about  $1\frac{1}{2}$  inches deep, turned upside down, and covered above with a circular covering of wood, to confine the heat. The handle to this cover is a strong cleat of wood, fastened to the circular wooden cover by means of four wood screws. This handle is distinctly represented in the figure.

The circular wooden cover for confining the heat must be constructed in pannels, and must be fastened to the shallow metallic dish by means of rivets, or wood screws. In doing this, all the precautions must be taken that are pointed out in the 5th chapter of this Essay, page 141; otherwise the wood and the metal will be separated from each other, in consequence of the shrinking of the wood, on its being exposed to heat.

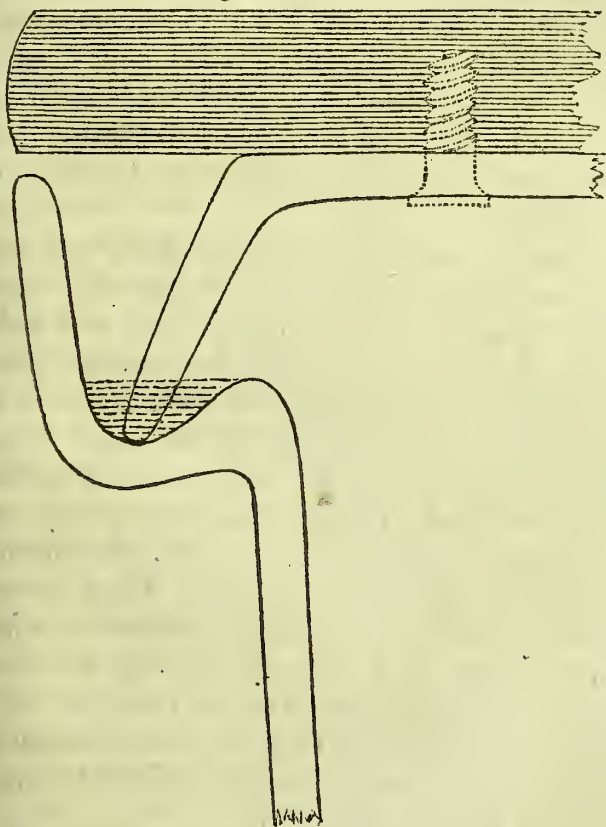
The inverted shallow dish, which, properly speaking, constitutes the cover of this boiler, may be made either of tin, or of sheet-iron, or of sheet-copper; or it may be made of cast-iron. Whatever the material is of which it is constructed, care must be taken to make it of such dimensions precisely, that its brim may enter the steam-rim, and occupy the lower or deepest part of it, otherwise the steam will not be properly confined in the boiler.

The following figure represents a vertical section, *of the full size*, of the steam-rim of one of these boilers (of cast iron) together with a section of a part of an inverted shallow cast-iron pan, which serves



as a cover to the boiler, and also of the circular covering of wood which is attached to the pan, and defends it from the cold air of the atmosphere.

*Fig. 45*



In this figure the steam-rim is represented as being full of water; and one of the screws is seen, which fasten the circular wooden cover to the in-



verted shallow pan, which confines the steam in the boiler.

On examining the two preceding figures, it will be found that both the boiler and its cover are of forms that will readily deliver from their moulds; and that circumstance will enable iron-founders to sell these articles at low prices.

The mass of brick-work, in which this boiler is set, may be a cube of 3 feet; or, by sinking the ash-pit in the ground, its height may be reduced to  $2\frac{1}{2}$  feet.

In order that the flame may be made to separate, and spread equally on all sides, under the lower boiler, the smoke should be made to pass off in two small canals, situated on opposite sides of the boiler. The openings of these canals may be a little below the level of the bottom of what has been called the upper boiler; and the smoke being made first to descend nearly to the level of the bottom of the lower boiler, may then pass off horizontally towards the chimney. The situation of the two horizontal canals (on opposite sides of the boiler) by which the smoke goes off, are indicated (in the figure 44.) by dotted lines.

So much has already been said in the foregoing chapters relative to the construction of closed fire-places for kitchen boilers, that it would be quite superfluous to give any particular directions respecting the construction of the fire-place for this boiler. The manner in which the boiler is set in

brick-work, and the means that are used for causing the smoke to surround it on every side, are distinctly shewn in the figure.

In order more effectually to confine the heat, the boiler should be entirely inclosed in the brick-work on every side, in such a manner that the brim of its steam-rim should not project above it more than half an inch. To preserve the brick-work from being wetted, the top of it may be covered with sheet-lead, which may be made to turn over the top of the brim of the steam-rim of the boiler.

There may either be a steam-tube in the cover of the boiler, or the steam may be permitted to force its way under the descending rim of the inverted shallow pan, which constitutes the cover. If there be a steam-tube, it should be half an inch in diameter, and about one inch in length; and it should be made very smooth on the inside, in order that another tube of tin, or of tinned copper, about 10 inches in length, may pass freely in it. The use of this moveable tube is to cause the air to be expelled from the upper boiler, while it is used for cooking with steam. This will be done, if, while the water below is boiling, the long tube be thrust down into the boiler through the steam-tube, till its lower end comes to the level of the brim of the lower boiler. For, as steam is considerably lighter than common air, it will of course rise up and occupy the upper part of the upper boiler, and the air below it being compressed, will escape through the tube we have just described; and, although

that tube should remain open, the upper boiler will, nevertheless, remain filled with steam, to the total exclusion of atmospheric air. The inside of the steam-tube, and the outside of the moveable tube should be made to fit each other with accuracy, in order that no steam may escape between them. The necessity of this precaution is too evident to require any illucidation.

It will be best to place the steam-tube within about an inch of the side of the cover, in which case it will be easy, by turning the cover about, to place it in such a position that the moveable tube may descend into the upper boiler, without being stopped by meeting with any of the dishes that are placed in it.

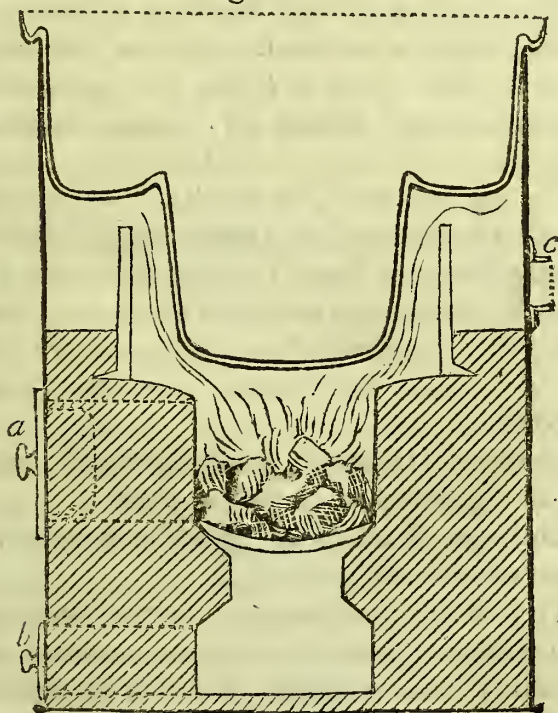
It is hardly necessary that I should observe here, that boilers on the principles above described may be constructed of sheet-iron, or sheet-copper, as well as of cast-iron, and that they may be made of any dimensions. That which is represented in the foregoing figure (44.) is of a moderate size, and would, I should imagine, be suitable for the family of a labourer, consisting of eight or ten persons. The lower part of the boiler would hold about  $3\frac{3}{8}$  gallons; but the whole boiler, filled up to within an inch of the level of the inside of the steam-rim, would hold  $14\frac{1}{4}$  gallons. When so filled up, I should suppose the boiler to be sufficiently capacious to heat water for washing, or for any other purpose that could be wanted by an industrious family,

family, consisting of the number of persons above-mentioned.

*Description of a PORTABLE FIRE-PLACE for an  
UNIVERSAL KITCHEN BOILER.*

The following figure represents a vertical section of the fire-place, with its boiler in its place.

*Fig. 46.*



This figure is drawn to a scale of 10 inches to the inch.

The



The boiler is supposed to be of cast-iron, and the section of it is represented by a double line. To render its form more conspicuous, its cover is omitted.

The portable fire-place is a cylinder of sheet-iron,  $24\frac{1}{4}$  inches in diameter, and  $34\frac{1}{4}$  in height, open above, and closed below. The sections of this cylinder, and of its bottom, are marked by strong black lines.

The fire-place, properly so called, is the center, or axis of this cylinder: it is built of fire-bricks and sturbridge clay; and the fire burns on a circular cast-iron dishing grate, eight inches in diameter.

The opening (at *a.*) by which the fuel is introduced, is marked by dotted lines; as is also another opening below it (at *b.*) which leads to the ash-pit. These openings are closed by doors of sheet-iron, which are attached by hinges to the outside of the cylinder, and fastened by means of turn-buckles.

The door of the ash-pit is furnished with a register for regulating the admission of air.

The smoke is carried off by an horizontal tube, a part of which is seen at *C.*

There is a particular and very simple contrivance for causing the smoke to come into contact with the sides of the lower boiler, and with the flat bottom of the upper boiler, and then to *descend* before it is permitted to pass off. This is a cylinder of cast-iron or of earthen-ware, which is 16 inches in diameter



diameter within, or in the clear, and 8 inches high, with a thin flanch about an inch wide, at its lower extremity. This flanch serves as a foot for keeping it steady in its vertical position, and also for fastening it in its place, by laying the ends of a circular row of short pieces of brick upon it. The lower end of this cylinder being set down at the level of the bottom of the lower boiler, upon the top of the hollow cylindrical mass of brick-work which constitutes the fire-place, the smoke is obliged to pass up between the inside of this cylinder and the outside of the lower boiler, and to strike against the flat bottom of the upper boiler. It then passes horizontally over the top of this cylinder, and turning downwards into the space which is left for it, between the outside of this short cylinder and the great cylinder of sheet-iron in which the boiler is suspended, it passes off by the small horizontal tube which carries it to the chimney.

This short cylinder is so distinctly represented in the figure, that letters of reference are quite unnecessary.

A piece of brick, or of fire-stone, about  $2\frac{1}{2}$  inches thick, is supposed to be attached to the inside of the fire-place door, to prevent its being too much heated by the fire; and this is represented in the figure by dotted lines. The knobs in the fire-place door, and in the door of the ash-pit, are designed to be used as an handle in opening them.

This

This portable fire-place may have two strong handles for transporting it from place to place; and as the boiler may be removed, and carried separately, the fire-place will not be too heavy to be carried very conveniently by two men.

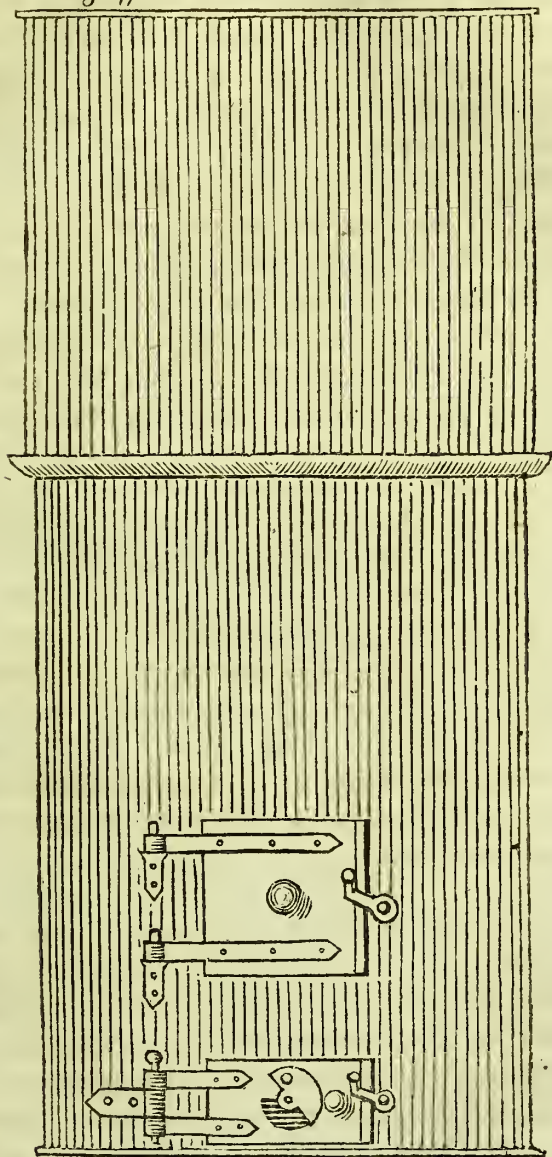
Without stopping to expatiate on the usefulness of this new implement of cookery, I shall proceed to shew how its utility may be made still more extensive. With a trifling additional expence, it may be changed into one of the very best stoves for warming a room in cold weather that can be contrived.— I say one of the *very best*, for it will warm the air of the room, without its being possible for it ever to heat it so much as to make it unwholesome; and it will do it with the least trouble, and at the expence of the least possible quantity of fuel.

*Description of a contrivance for warming a room, by means of a* PORTABLE UNIVERSAL KITCHEN BOILER.

The following figure represents an elevation, or front view of the machinery that may be used for this purpose.

This

*Fig. 47*



This machinery is very simple : It consists of the

portable boiler and fire-place represented in the preceding figure (46.) with an inverted cylindrical vessel, constructed of tin, or of very thin sheet-copper, placed over the boiler. This cylindrical vessel, which I shall call a *STEAM-STOVE*, must be just equal in diameter, to the steam-rim of the boiler, at the lowest or deepest part of that rim; and it may be made higher, or lower, according to the size of the room that is to be heated by it. That represented in the foregoing figure is 26 inches in diameter, and 24 inches high; which gives 17 square feet of surface for heating the room.

This *steam-stove* may be made of common sheet-iron; but in that case it should be japanned within and without, to prevent its rusting. In japanning it, it might be painted, or gilded, and rendered very ornamental. The portable fire-place might likewise be japanned and ornamented; but in that case it would be necessary to line that part of it with clay or cement, with which the smoke comes into contact, otherwise the heat, in that part, might injure the japan.

There must be a small tube, about  $\frac{1}{4}$  of an inch in diameter, in one side of the steam-stove, just above the top of the steam-rim of the boiler. This tube should be about two inches in length, and it should project inwards, horizontally, into the cavity of the steam-stove. Into this tube, one end of another longer tube should be introduced, which



is designed to carry off the redundant steam into the chimney.

The reason why this tube should be placed near the bottom of the steam-stove, will be evident to those who recollect that steam is lighter than air. Were it placed at the top of it, no steam would remain in the stove, and the object of the contrivance would be defeated.

This small steam-tube at the lower part of the stove may, with safety, be kept quite open; for unless the water in the boiler be made to boil with vehemence, little or no steam will issue out of it; for the greater part, if not the whole of it, will be condensed against the top and sides of the steam-stove.

As the water which results from this condensation of steam, will all return into the boiler, it will seldom be necessary to replenish the boiler with water.

When cooking is going on in the boiler in cold weather, the steam-stove will supply the place of a cover for the boiler; but when the weather is warm, the cover of the boiler may be used instead of it, and the air of the room will be very little heated.

Steam-stoves on these principles would be found very useful in heating halls and passages, and I think



think they might be used with advantage for heating elegant apartments. They are susceptible of a variety of beautiful forms, and are not liable to any objections that I am aware of. A most elegant steam-stove might be made in the form of a doric temple, of eight or ten columns, standing on a pedestal. The fire-place might be situated in the pedestal, and the columns and dome of the temple might be of brass or bronze, and made hollow to admit the steam. In the center of the temple a small statue might be placed, as an ornamental decoration—or an argands lamp might be placed there to light the room. In case a lamp should be placed in the center of the temple, there should be a circular opening left in the top of the dome for the passage of the smoke of the lamp.

The fire under the boiler may be lighted and fed without the room, or within it; or the steam may be brought from a distance in a leaden pipe or copper tube. If the boiler that supplies the steam is situated in the pedestal of the temple, and if the fire is lighted from within the room, the fire-place and ash-pit doors may be masked by tablets and inscriptions.

But I need not enlarge on the means that may be used for rendering an useful mechanical contrivance ornamental and expensive; for many persons will be ready to lend their assistance in that undertaking.

Those

Those who wish to see one of these universal kitchen boilers, will find one set in brick-work, in the kitchen of the Royal Institution. It is constructed of copper, and tinned on the inside; and it is considerably larger than that I have here described. The method used for confining the steam in this boiler is different from that here recommended; and there is a contrivance for heating the contents of the boiler occasionally by means of steam, which is brought from another boiler; but this contrivance has no particular connection with the invention in question, and is introduced here merely to show how steam may be employed for making liquids boil.

In order that these universal kitchen-boilers, with steam-stoves, may the more easily find their way into common use in this country, some method should be contrived for making tea in them. Now I think this might be done by putting the tea, with cold water, into a shallow tin tea-pot, or rather kettle, and placing it in the upper boiler, directly over the lower boiler. I once made an experiment of this kind; and if I was not much mistaken, the tea that was so made was uncommonly good, and high flavoured. It certainly appeared to be considerably stronger than it would have been, if, with the same quantities of tea and of water, it had been made in the common way.

Boiling water poured upon a vegetable substance does not always extract from it all that might be extracted, by putting the substance to cold water, and heating them together. This fact is well known; and it renders it probable that the method here proposed, of making tea, would be advantageous. If this should be the case, no implement could be better contrived for that purpose than our universal kitchen boiler.

CHAP. X.

*Description of a new-invented REGISTER-STOVE or FURNACE, for heating Kitchen Boilers, Stew-pans, &c.—Of the construction of Boilers and Stew-pans, peculiarly adapted to those Stoves.—Particular method of constructing Stew-pans and Sauce-pans of Tin, by which they may be rendered very durable.—Description of a small PORTABLE FIRE-PLACE for Stew-pans and Sauce-pans.—Of cast-iron HEATERS for heating Kitchen Utensils.*

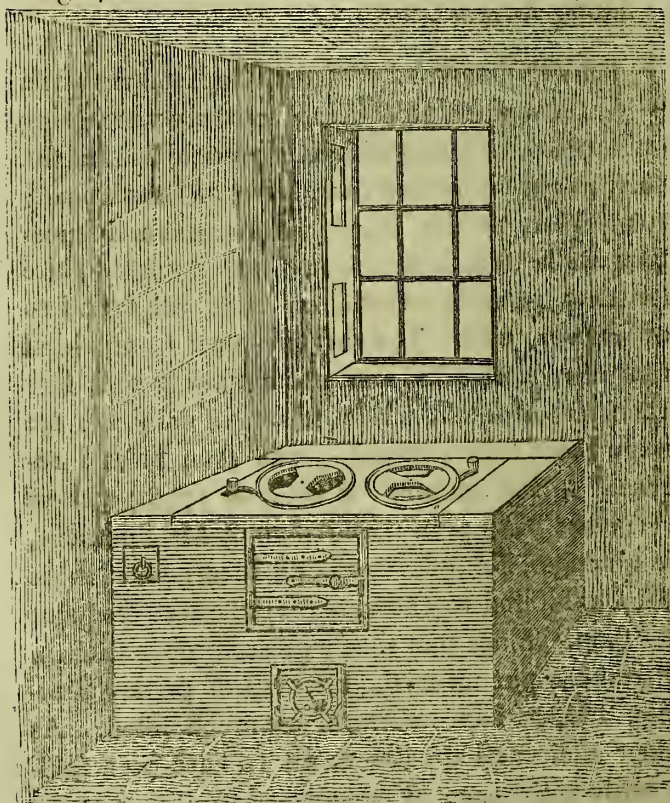
HAVING learnt, by frequenting Kitchens while the various processes of cookery were going on in them, how very desirable it would be that the cook might be enabled to regulate, and occasionally to moderate the fires by which stew-pans and sauce-pans are heated, I set about contriving a fire-place for that purpose, which, on trial, was found to answer very well. The first fire-place of this kind that was constructed was put up in my own kitchen, at Munich, where it was in daily use for more than twelve months; and soon after I returned to this country (in the year 1798.) one of them was put up in the kitchen of Mr. Summers, ironmonger, No. 98, New Bond-street, where it has been exhibited to the view of those who frequent his shop. Since that time a great number of them have been put up in the kitchens of private families, and, as I am informed, are much liked. As their usefulness appears to me to have been sufficiently ascertained by experience to authorize me



to recommend them to the public, I shall now lay before the reader the most exact and particular description of them that I can give; premising however, that it will be difficult to give so clear an account of this contrivance as to enable a person to form a perfect idea of it without having seen it.

I shall perhaps be most likely to succeed in this attempt, if I begin by exhibiting a view of the thing to be described.

*Fig: 48*



This plate represents a view of a register-stove  
fire-

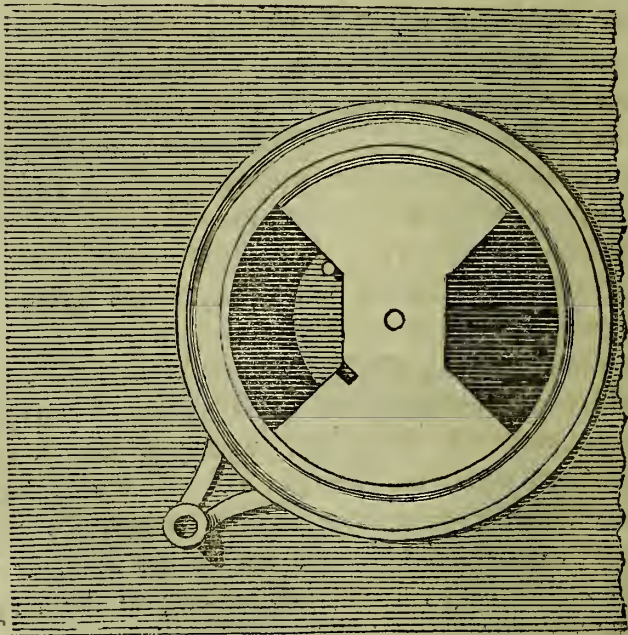


fire-place for two stew-pans, actually existing in Heriot's Hospital at Edinburgh. It is placed in a mass of brick-work, two feet six inches high, four feet six inches long, and two feet wide, from front to back, situated in a corner of the room, on the right hand side of the fire-place. In the middle of the front of this mass of brick-work are seen, the front of the fire-place door (which is double) —and the ash-pit register-door;—and near the end of it, on the left, in the upper front corner, may be discovered the stone stopper, which closes a canal, which is occasionally opened for cleaning out the foot from the flues in the interior parts of the mass of brick-work. A like stopper, and which serves for a like purpose, may be seen at the end of the mass of brick-work, near the right hand corner above. Each of these stoppers is furnished with an iron ring, fastened by a staple, which serves as a handle in removing and replacing it.

On the top of this mass of brick-work there is laid an horizontal plate of cast-iron, 18 inches wide, three feet long, and about  $\frac{1}{4}$  of an inch in thickness; and on the right and left of this iron plate, and level with its upper surface, there are placed two flat stones, each nine inches wide, and 18 inches long; being just as long as the iron plate is wide.

At the back of this iron plate runs a flue, four inches wide and five inches deep, which is covered above, at the level of the upper surface of the iron plate, with a flat stone, six inches wide.

One of the most essential parts of this contrivance is the iron plate, with its circular register ; both which are represented by the following figure. In order to give this figure upon the largest scale the space which it must occupy will admit of, only one half of the plate is represented, being shewn broken off in the middle.

*Fig. 49*

In this figure the circular moveable register (which is distinguished from the oblong plate to which it belongs, by marking the latter by fine horizontal lines) is shewn in its place; and the projecting piece of metal is also seen, which serves as a handle to turn it about on its centre. This circular register has a shallow circular groove, near its circumference, about  $\frac{1}{2}$  an inch deep and  $1\frac{1}{4}$  inches wide; and between the inside of this groove and the centre of the register there are two holes, or openings, on opposite sides of the centre, which answer to two other openings of like form and dimensions, which are in each half of the oblong plate to which the registers belong. By one of these openings (that next the middle of the oblong plate) flame rises from a fire situated below, and spreads under the bottom of a boiler, which is suspended over the circular register; and by the other it descends, and again entering the mass of brick-work, it goes off by an horizontal canal which communicates with the chimney.

The boiler, or stew-pan is suspended over the circular register-plate, and the heat is confined about it by means of an hollow cylinder of sheet-iron, or of earthen ware (about one inch longer, or higher than the boiler is deep) and open at both ends; the lower end of which entering the shallow groove of the register, reposes on it, while its upper end is closed by the boiler, which, resting on it by its brim, is suspended in it, and consequently is surrounded by the flame.

This cylinder must be made quite flat, or even at its two ends, by grinding it on a flat stone; and the boiler must be made to fit it accurately, not however by fitting too nicely into its opening (which method would not be adviseable)—but by making the under part of the iron ring, which forms the projecting brim of the boiler, perfectly flat, and causing the boiler to be suspended by that ring on the flat end of the cylinder.

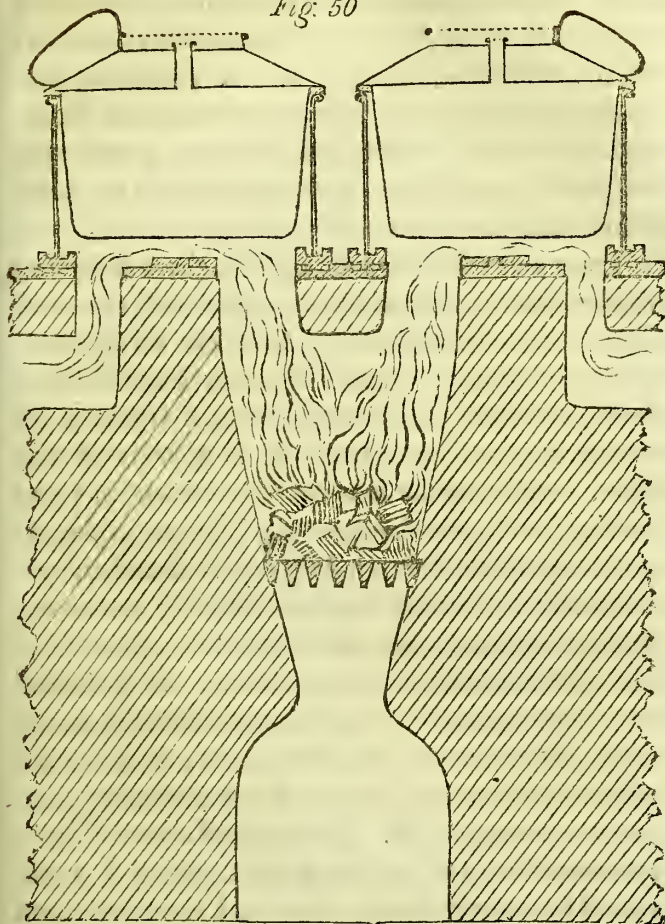
To prevent the escape of the flame under the bottom of the cylinder, or between its lower end and the circular register-plate on which it stands, a small quantity of sand, or (what will be still better) of fine filings of iron or brass, may be put into the groove in which the cylinder is placed; and the same means may be used for making the joinings tight between the circular registers and the flat plate to which they belong.

The following figure, which shews a vertical section of this register-stove, with its fire-place and its two boilers, or rather stew-pans, will give a clear idea of the arrangement of the machinery.

These



*Fig. 50*



These stew-pans, which are  $10\frac{1}{2}$  inches in diameter above, and 6 inches deep, each, are constructed according to the directions given in the seventh chapter of this Essay. They are of copper, tinned, and are turned over flat iron rings at their brims.

Their



Their handles are not seen in this figure, having been omitted for want of room. Their covers, which are of tin, and made double, are on a peculiar construction. They are so contrived that a small saucepan for melting butter, or warming gravy, may be placed upon them, and heated by the steam from their stew-pans.

From a careful inspection of the three foregoing figures, and a comparison of them with the short description that has been given of the various parts of this machinery, it will, I fancy, be possible to form so distinct an idea of this contrivance as to enable any person, conversant in matters of this kind, to imitate the invention, even without ever having seen the work executed. The principles, at least, on which this contrivance is founded, will be perfectly evident; and when they are understood, ingenious men will find little difficulty in the application of them to practice. It is indeed highly probable that simpler and better means of applying them will be found, than those I have adopted, when the use of the contrivance shall become more general. I am indeed aware of several alterations of the machinery, which I think would be improvements: but as I have not tried them, I dare not recommend them, as I recommend things which I know from experience to be useful.

I shall now proceed to give an account of several precautions in the construction and use of these  
register-

register-stoves for boilers, which have been found to be necessary and useful.

The circular registers are so constructed, that by turning them round, they may be so placed as either to close entirely the holes in the flat plate on which they lie, or to leave them open more or less. Now as there is no passage, by which the smoke can go off from the fire-place into the chimney, but through these holes, care must be taken never to attempt to kindle the fire when both these registers are closed;—and never to open one of them without having first placed an hollow cylinder on it, and a fit sauce-pan or boiler in the cylinder, to close it above. It can hardly be necessary that I should add, that care must always be taken to put water, or some other liquid, into the boiler, to prevent its being burnt and spoiled by the heat.

The state of the register—in regard to its being more or less open—cannot be seen when the boiler is in its place, as the openings of the register are concealed by it, and by the cylinder in which it is suspended. But although the state of the register under these circumstances, is not *seen*, it is nevertheless *known*; and the heat which depends on the dimensions of the opening left for the passage of the flame, may, at any time, be regulated with the utmost certainty. By means of a projecting pin, or short stub, represented in the figure 49, belonging to the lower (fixed) plate—and which is cast with it—the moveable circular register is stopped in two different positions; in one of which the  
openings

openings for the flame are as wide as possible, and in the other they are quite closed. When the handle, by which the circular plate is turned round, is pulled as far forward as possible towards the front of the brick-work, the register is wide open. In this situation it is represented in the figure 49. When it is pushed as far backwards as possible, the register is closed; and its situation at any intermediate station of the handle, between these two limits of its motion, will at any time shew the exact state of the register.

That the handles of the register plates may not interfere with each other, they are placed on the sides of their plates, which are farthest from the fire; consequently they are as far from each other as possible. The form of these handles is such that they never become very hot, although they are of iron, and of a piece with their plates, being cast together. The cold air of the atmosphere passing freely upward through a conical hole (left in casting) in the center of the knob of the handle, the heat is carried off by this current of air, almost as fast as it arrives from the circular plate.

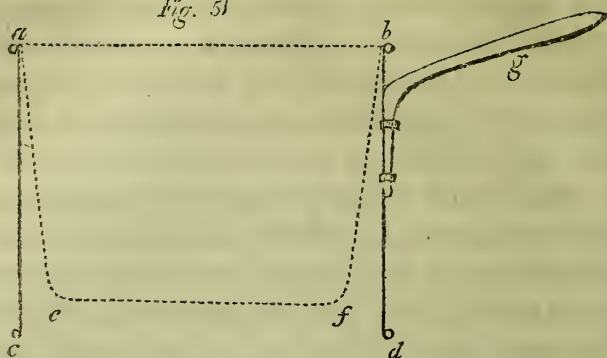
There is a circumstance to which it is absolutely necessary to pay attention in setting the large flat iron plate in the brick-work, otherwise the machinery will be liable to be soon deranged, by the effects of the expansion of the metal by heat:—The bottom, or under side of this plate must be every where completely covered and defended from the action of the flame by bricks or tiles. This is  
very

very easy to be done, but, at the same time, as it requires some care and attention, it is what workmen are very apt to neglect, if they are not well looked after.—As this plate is very large, if great care be not taken to prevent its being exposed to the flame, it will soon be warped and thrown out of its place. If, instead of casting this plate in one piece, it be formed of two pieces, each 18 inches square, the bad effects produced by the expansion of the metal by heat will be greatly lessened; and this precaution has been taken in most of the register-stoves on these principles that have been put up in London; but by an experiment lately made at Heriot's hospital at Edinburgh, I have been convinced that the large plates may be depended on, if they are properly set.

I have described the cylinder in which the stew-pan or boiler is suspended, as being a separate thing:—it is right, however, that I should inform the reader, that in almost all cases where register fire-places of this kind have hitherto been put up, this cylinder has been firmly and inseparably united to the stew-pan, so much so as to make a part of it, the handle even being attached to this cylinder, instead of being joined immediately to the stew-pan. The following figure, which represents a vertical section of one of these stew-pans, and its cylinder, will shew how they have hitherto generally been constructed.



Fig. 51

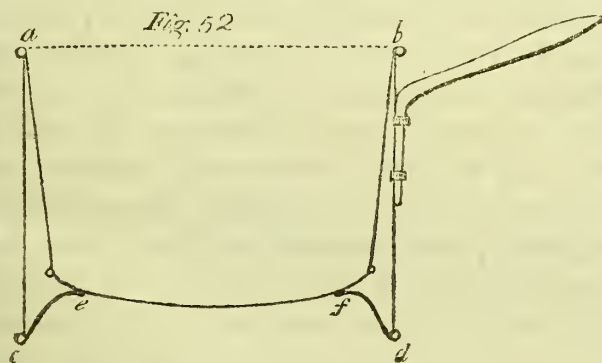


*a, b, c, a*, represents a vertical section of the cylinder, which is  $11\frac{1}{2}$  inches in diameter, and 8 inches high. Into this cylinder, which is open at both ends, the boiler or stew-pan, *a, e, f, d*, (which is distinguished by dotted lines) is made to pass with so much difficulty, as to require a considerable force to bring it into its place, and not to be in danger of being separated from it by any accidental blow. The handle *g*, is rivetted to the cylinder previously to its being united to its stew-pan.

It having been found that this cylinder was liable to become very hot, and even to be destroyed by the heat in a short time, if care was not taken to keep the fire low; and it having likewise been found that the heat that made its way upwards, between the outside of the stew-pan and the inside of the cylinder, frequently heated the upper part of the stew-pan so intensely hot, as to cause the victuals cooked in it to be burnt to the sides of the  
stew-



stew-pan, especially when the stew-pan was almost empty. With a view to remedy both these evils, and at the same time to construct stew-pans and fauce-pans of large dimensions of common sheet-tin (tinned iron) which should be more durable, and superior in many respects to those of that material now in common use, some alterations were made in this utensil, which will be easily understood by the help of the following figure.



In order to prevent the flame from passing upwards between the fauce-pan and its cylinder, and occupying the vacant space, *c, a, e*, this space was inclosed by means of a circular piece of sheet-copper, *c, e, f, d*, with a large circular opening in its center, of the diameter, *e f*. This copper being a little larger in diameter than the cylinder, was firmly attached to it all round, by being turned over the same wire which strengthened and made a finish to the bottom of the cylinder; while the inside edge,

*e,*

*e, f*, of this circular perforated sheet of copper being raised upwards, with the hammer, about an inch, as it is represented in the figure, the sauce-pan is made of such a form, that, on being brought into its place, its bottom is forced down upon the upper edge of this copper; by which means the empty space between the sauce-pan and its cylinder is closed up below by the copper, and the flame prevented from entering it. Sheet-iron might have been used instead of sheet-copper, for closing up this space; but copper was preferred to it on account of its not being so liable as iron to be destroyed by the action of the flame.

This contrivance was found to answer so well for preventing the cylinder from being destroyed by heat, that, when it was made of tinned sheet-iron, (commonly, but improperly, called tin) the tin, by which the surface of the iron was covered, was not melted by it: and so completely did it prevent the sides of the sauce-pan from becoming too hot, that a quantity of fluid, of any kind, so small as barely to cover the bottom of the vessel, might be boiled in it, without the smallest danger of its being burnt to its sides.

Having found that the sides of the sauce-pan were so effectually defended by this contrivance from intense heat, it occurred to me that a sauce-pan of common tin might perhaps be so constructed, as, with this precaution for the preservation of its sides, it might be made to last a great while; which would not only save a considerable

expence for kitchen utensils—tin being much cheaper than copper—but would also remove the apprehension of being poisoned by any thing injurious to health, communicated to the food by the vessel in which it is prepared; which those cannot help feeling, who eat victuals cooked in copper utensils, and who know the deleterious qualities of that metal.

Concluding that if I could contrive to prevent the seams or joinings of the tin, in a sauce-pan or boiler, from ever coming into contact with the flame of the fire, it could not fail to contribute greatly to the durability of the utensil; I caused the sauce-pan, represented in the foregoing figure, to be made of that material. The bottom of this sauce-pan, *e, f*, was made dishing (instead of being flat, as the bottoms of tin sauce-pans are commonly made) and being joined to the body of the sauce-pan by a strong double seam, the vacuities of the seam, both within and without, were well filled up with solder.

Now as care was taken in adjusting the conical band of copper *c, e, f, d*, to the bottom of the sauce-pan, to make its circular opening above, at *e, f*, something less in diameter than the bottom of the sauce-pan at its extreme breadth, or where it joins the sides or body of the utensil; and also to cause the upper edge of this copper actually to touch the bottom of the sauce-pan, and even to press against it in every part of its circumference, it is evident that the seam, by which the body of the sauce-pan and its dishing bottom were united, was completely covered by the copper, and de-

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fended from the intermediate action of the fire : it is likewise evident, that the side-seams in the body of the sauce-pan, were likewise protected most effectually from all the destructive effects of intense heat : and if care were taken to cover the outside of the body of the sauce-pan with a good thick coating of japan, to prevent its being injured by rust, there is little doubt but that sauce-pans so constructed would last a long time indeed.

The cylinder in which the sauce-pan is suspended might likewise be japanned—both within and without—which would not only preserve it from rust, but would also give it a very neat appearance. All these improvements have been made, and a variety of sauce-pans constructed on the principles here recommended may be seen in the Repository of the Royal Institution.

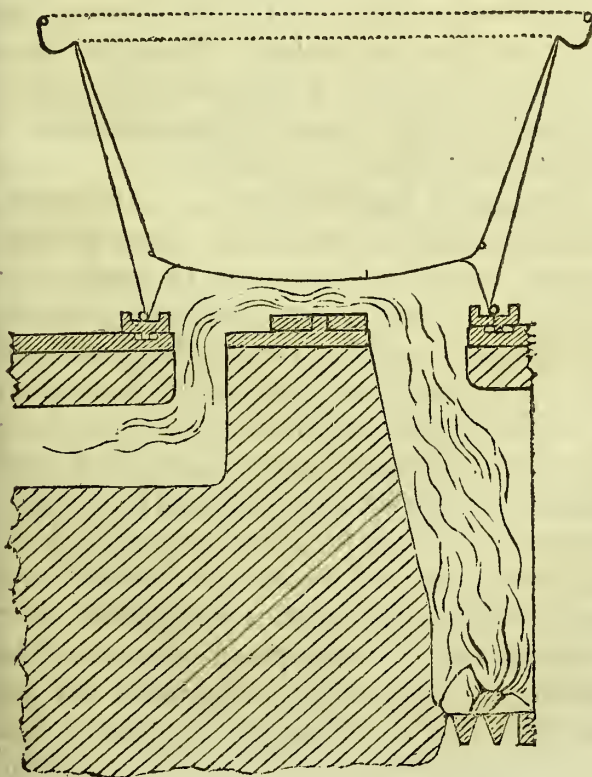
*Of the means that may be employed for using indifferently Sauce-pans and Boilers of different sizes, with the same Register-Stove Fire-place.*

Although the diameter, below, of the cylinder or cone (for it may be either the one or the other) in which the sauce-pan or boiler is suspended, is limited by the diameter of the groove of the circular register-plate in which it stands over the fire ; yet, the sizes of the cooking utensils used with them may be greatly varied. They may, without the smallest inconvenience, be made either broader or narrower above at their brims, than the bottom of the cylinder or cone in which they are suspended ; and, with any given breadth above, their depths (and consequently their capacities) may be



varied almost at pleasure. When, however, the diameter of one of these boilers, at its brim, is greater than the diameter of the groove of the register-plate of the fire-place, it must be suspended in an inverted hollow cone, and its body must necessarily be made conical.

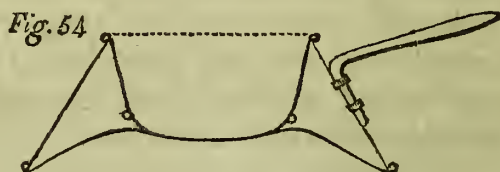
The following figure shews how a boiler, 15 inches in diameter, with a steam-rim (with which the steam-dishes of a 15 inch family boiler may occasionally be used) may be adapted to a register-stove fire-place of the usual dimensions.

*Fig. 53*



This boiler requires no handle, as its steam-rim may be used instead of a handle in moving it from place to place.

The following figure shews how very small sauce-pans are to be fitted up, in order to their being used with these register-stove fire-places.



This sauce-pan is only six inches in diameter, at its brim, and three inches deep. The hollow cone in which it is suspended is about six inches in diameter above— $10\frac{1}{2}$  inches in diameter below—and four inches in height.

In kitchens of a moderate size it will seldom be convenient to devote more space for stoves for stew-pans and sauce-pans than would be necessary for erecting one register stewing-stove fire-place, which, if the fire-place has only two registers, will heat only two stew-pans or boilers at the same time; but in cooking for a large family it will frequently be necessary to have culinary processes going on at the same time in several stew-pans and sauce-pans; it remains therefore to shew how this may be done, with the apparatus and utensils just described: and it is certain that this object is so important, that any arrangement of culinary apparatus would be essentially deficient and imperfect, which did not afford the means of attaining it completely, and without

without any kind of difficulty. There are two ways in which it may be done with the utensils above described: A stew-pan or sauce-pan having been placed upon one of the register-plates of the stove till its contents are boiling hot, it may be removed, and placed over a very small fire made with charcoal in a small portable furnace resembling a common chafing dish;—or it may be set down upon a circular iron heater, made red hot, and placed in a bed of dry ashes, in a shallow earthen pan. By either of these methods a boiling heat may be *kept up* for a long time in the stew-pan; and any common process of boiling or stewing carried on in a very neat and cleanly manner. It must however be remembered, that it is only with stew-pans and boilers constructed on the principles here recommended, and constantly kept well covered, with double covers, to prevent the loss of the heat, that the processes of boiling and stewing can be carried on with very small portable furnaces, and with heaters; but with these utensils, which are so well calculated to confine the heat, it is almost incredible how small a supply of heat will be sufficient, when the contents of the vessel have previously been made boiling hot, to keep up that temperature, and carry on any of the common processes of cookery.

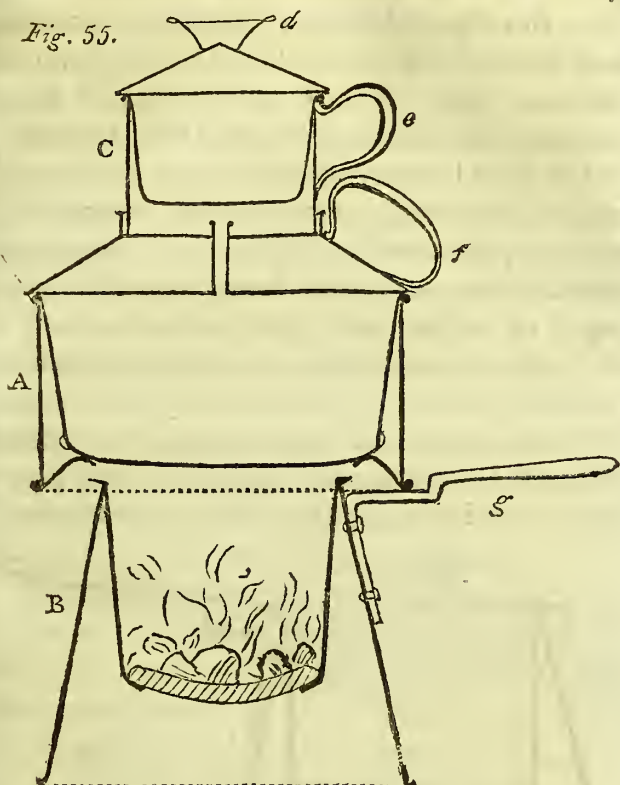
In the following figure (55.) A, represents a vertical section of a stew-pan, 11 inches wide at its brim, and 6 inches deep, suspended in its cylinder,

and placed upon a *portable furnace*, B, which is 7 inches in diameter at its opening above, 11 inches in diameter below, and 9 inches high. A small sauce-pan, C, for melting butter, is placed on the cover of the stew-pan, and is heated by the steam from the stew-pan.

This small sauce-pan is suspended in a cylinder, which serves for confining the steam about it, which rises from the stewing stove.

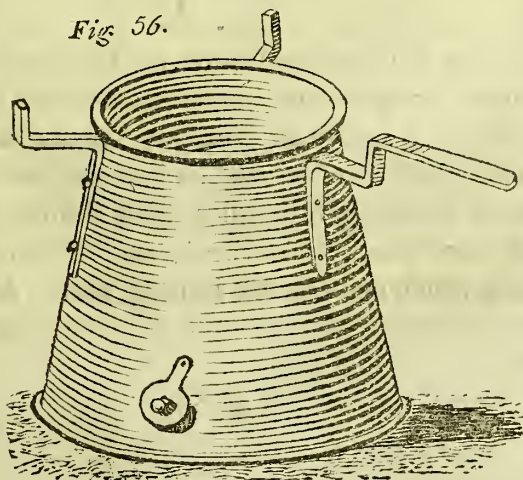
The cover of this small sauce-pan is double, and, instead of an handle, it is furnished with a kind of a knob (*d*) formed of an hollow inverted cone of tin, which occasionally serves as a foot for supporting the cover, when it is taken off from the sauce-pan, and laid down in an inverted position. This contrivance is designed to prevent the inside of the cover from being exposed to dirt, when it is occasionally taken off, and laid down. The sauce-pan is furnished with a handle of the common form (*e*) which is represented in the figure.—The handle (*f*) of the stew-pan is also shewn; and that (*g*) of the portable fire-place.

Fig. 55.



The following figure is a perspective view of the portable furnace, without the stew-pan :

Fig. 56.

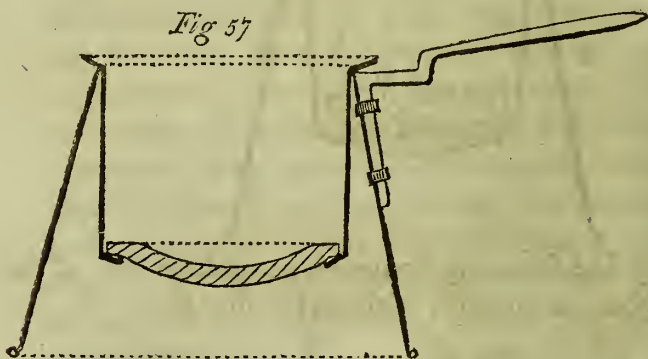




In this figure the three horizontal projecting arms are distinctly seen, which serve to support the stew-pan. One of these arms, which is longer than the rest, serves as an handle to the furnace.

This little furnace, which is constructed principally of sheet-iron, is made double, that part of it which contains the burning charcoal being cylindrical, or nearly so, and being suspended in the axis of an hollow cone, which forms the body of of the furnace, and serves as a covering for confining the heat.

The following figure, which represents a vertical section of this furnace through its axis, will give a clear idea of the manner in which it is constructed.



The air is introduced into the fire-place, first through a circular hole (represented in the figure 56.) about  $1\frac{1}{2}$  inches in diameter, situated in the side of the hollow cone near its bottom; and from thence it passes up through a small dishing grate of cast-iron, which lies at the bottom of the hollow cylinder which contains the burning fuel. At the upper

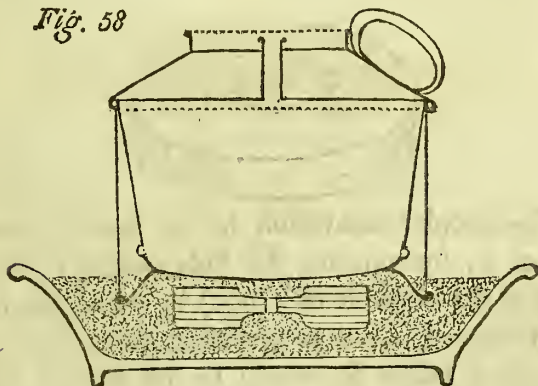


upper end of this cylinder there is a narrow rim, about half an inch wide, turned outwards, by which the cylinder is suspended in its place; and a similar rim being turned inwards below, serves as a support for the dishing grate.

When this fire-place is used, it will be proper to place it on a flat stone, or on a tile; or, what will be still better, to set it in a thin earthen dish.

The same earthen dishes which would be proper for holding these portable fire-places, would also answer perfectly well for holding the cast-iron heaters that may occasionally be used for finishing the processes of cooking that have been begun in stew-pans and sauce-pans, heated over the fire of a register-stove, or otherwise made boiling hot.

The following figure, which represents a vertical section of a stew-pan, placed over a heater of the kind here recommended, will give a perfect idea of this arrangement.

*Fig. 58*

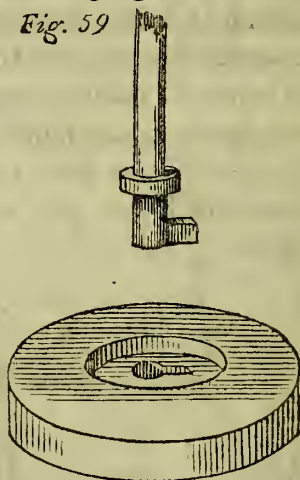
The heater is here represented as lying in a bed of ashes, and there is likewise a thin layer of  
ashes

ashes seen between the top of the heater and the bottom of the stew-pan. By the quantity of ashes suffered to remain on the upper surface of the heater, the heat communicated to the stew-pan is to be moderated, and regulated.

The heater is perforated in its center, by a hole of a peculiar form, which serves for introducing an iron hook, which is used in taking it from the fire, and placing it in the earthen dish.

The form of the hook, and the shape of the aperture through which it passes in the heater, may be seen in the following figure :

*Fig. 59*



The circular excavation in the heater, on each side of it, surrounding the hole (which is in the form of the key-hole of a lock) by which the hook is introduced, serves to give room for the hook (or key, as it might be called) to be turned round when the heater is laid upon, or against a flat surface. As this excavation, as well as the hole through which the key passes, may be cast with the heater, this arrangement will cause no additional expence.

## CHAP. XI.

*Of the use of PORTABLE FURNACES, for culinary purposes.—Description of a portable Kitchen Furnace, for Boilers, &c. on the common construction.—Description of a small Portable Furnace of cast-iron, for heating tea-kettles, stew-pans, &c.—Description of another, of sheet-iron, designed for the same uses.—Description of a Portable Kitchen Furnace of earthen ware.—An account of a very simple Apparatus for Cooking, used in China.*

**I**N China, and in several other countries, all, or nearly all the fire-places used in cooking are portable; and real advantages might certainly be derived, in many cases, from the use of portable kitchen fire-places in this country. Convinced of the utility of this method of cooking, I have taken considerable pains to investigate the subject experimentally, and to ascertain the best forms for the furnaces and utensils necessary in the practice of it.

Portable furnaces for cooking are of two distinct kinds : The one has a fire-place door for introducing the fuel—the other has none : and either of these may, or may not, be furnished with a tube for carrying off the smoke into the air, or into a neighbouring chimney.

When a portable kitchen furnace is constructed without a fire-place door, as often as fuel is to be introduced, it will be necessary to remove the boiler, in order to perform that operation. When the boiler is small, that may easily be done ;

done; and when the furnace stands out of doors, or on the hearth within the draft of a chimney, or when the fuel used produces little or no smoke, it may be done without any considerable inconvenience; but if the boiler be large, it cannot be removed without difficulty; and when the furnace is placed within doors, and the fuel used produces smoke, or other noxious vapours, the removing of the boiler, though it were but for a moment, would be attended with very disagreeable consequences.

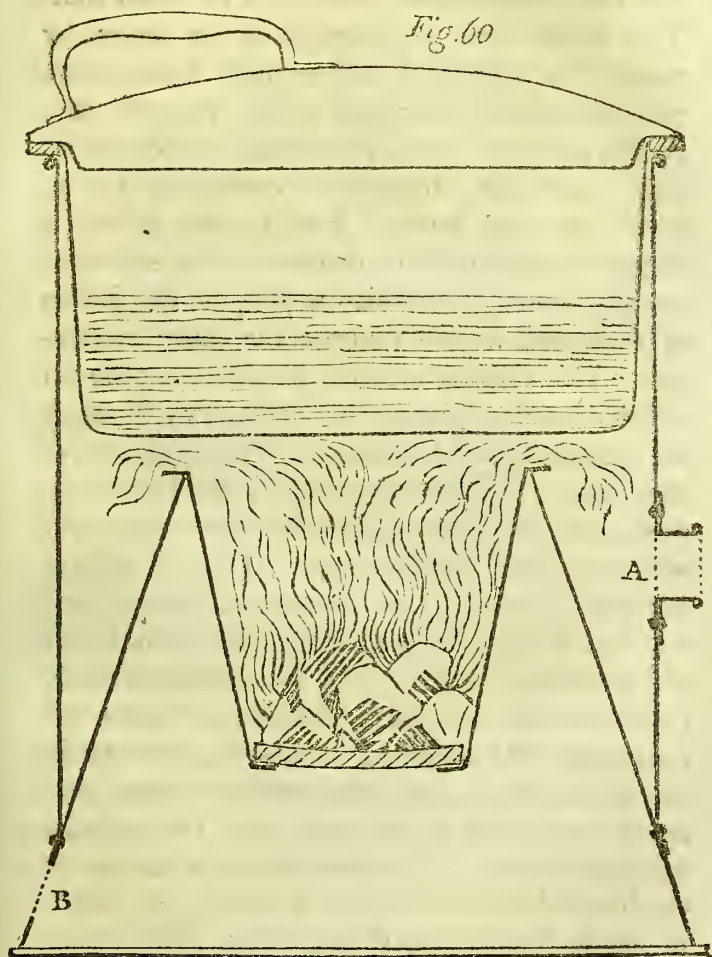
Small portable furnaces, without fire-place doors, may may be used within doors, provided they be heated with charcoal; but it will in that case always be advisable to furnish them with small tubes of sheet-iron, for carrying off the unwholesome vapour of the charcoal into the chimney. Without such tubes to carry off the smoke, they would not, it is true, be more disagreeable, or more detrimental to health, than the stoves now generally used for burning charcoal in kitchens; but I should be sorry to recommend an invention to which there appear to me to be so great objections.

I have caused a considerable number of portable kitchen furnaces, of both the kinds above-mentioned, to be constructed; and I shall now give descriptions of such of them as seem to answer best the purposes for which they were designed. They may all be seen at the Repository of the Royal Institution.

A very



A very simple and useful portable kitchen furnace, with its stew-pan in its place, are represented by the following figure :



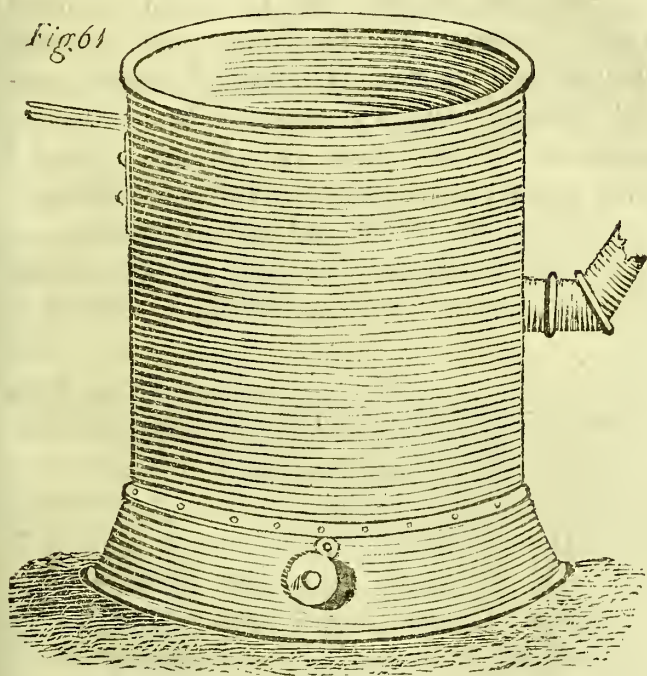
This furnace is made of common sheet-iron, and it may be afforded at a very low price. It is composed



Composed of an hollow cylinder, and two hollow truncated cones of different sizes. The large cone, which is erect, is closed at its base, or lower end. The smaller is inverted, and is open at both ends. This smaller cone is suspended in the larger, by means of a rim about half an inch wide, which projects outwards from its upper (larger) end. A rim of equal width, projecting inwards, at its lower extremity, supports a circular grate, on which the fuel burns. The cylinder, which is about two inches less in diameter than the larger cone at its base, and which rests upon the surface of that cone, serves to support the boiler or saucepan. This cylinder is firmly fixed to the cone on which it rests, by means of rivets, two of which are represented in the figure. The upper end of this open cylinder is strengthened, and its circular form preserved by means of a strong iron wire, over which the sheet-iron is turned. There is a short horizontal tube (A.) on one side of the cylinder, which is destined for receiving a longer tube which carries off the smoke. The air necessary for the combustion of the fuel is admitted through a circular hole (B.) about  $1\frac{1}{4}$  inches in diameter, in the side of the larger cone, near its bottom, and below the joining of the cone with the cylinder which rests on it. This hole for the admission of air should be furnished with a register, by means of which the fire may be regulated. The handle of the stew-pan is omitted in this plate, for want of room, as is also that of the fire-place. This figure is drawn to a scale of four inches to the inch.

The

The following figure (which is drawn to a scale of six inches to the inch) is a perspective view of one of these portable furnaces, without its stew-pan.

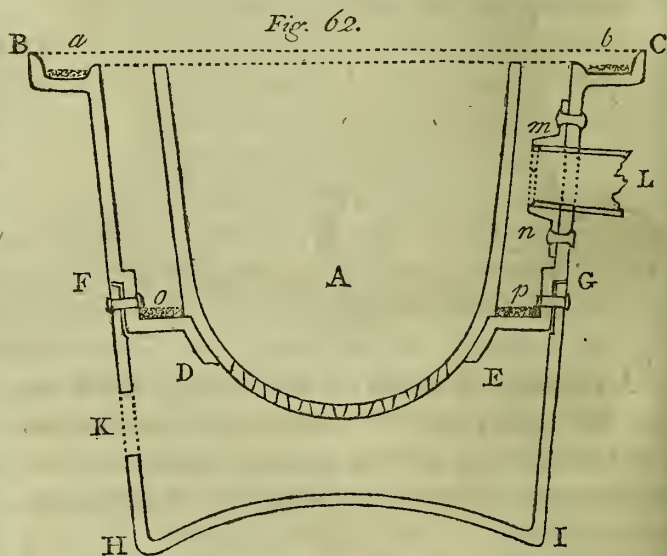


A part of the handle of this furnace is seen on the left hand; and the short tube is seen on the right hand, that receives another tube, (a part of which only is shewn) by which the smoke passes off.

The stew-pan represented in the 60th figure, is supposed to be made of copper, and to be constructed on the principles recommended in the seventh

seventh chapter of this (tenth) Essay. These portable furnaces are peculiarly adapted to kitchen utensils, constructed on those principles, and also to boilers and stew-pans with steam-rims, which are not made double; but for double or *armed boilers*, stew-pans, &c. the furnace must be made in a different manner. The simplest form for portable furnaces adapted to armed boilers, is that represented by the figures 55, 56, and 57: but I shall now give an account of a furnace of this sort, constructed on different and better principles.

The following figure represents a vertical section of a small portable kitchen furnace, of *cast-iron*:



On examining this figure, it will be found that care has been taken in contriving this furnace, to divide it in such a manner into parts, and to give

to those parts such forms as to render the whole of easy construction. It consists of three principal parts, namely, of the fire-place *A*, which is a hollow cylinder, or rather an inverted hollow truncated cone, 7 inches in diameter above, measured internally; 4 inches long, or high, ending below with a hemispherical hollow bottom, 6 inches in diameter, perforated with many holes for the admission of air.

This fire-place is suspended in the axis of the furnace by means of the projecting hollow ring *D*, *E*, belonging to the upper and principal piece, *B*, *C*, *D*, *E*, of the furnace. At the upper part of this piece there is a circular cavity, *a*, *b*, about one inch wide, and a quarter of an inch deep, which is destined to receive the lower extremity of the hollow cylinder in which the boiler is suspended. At *L*, is a circular hole  $1\frac{1}{4}$  inches in diameter, which receives the end of the tube by which the smoke is carried to the chimney. A part of this tube, which is of sheet-iron, is represented in the figure. To give it a more firm support in its place, there is a short tube, *m*, *n*, of cast-iron, which projects inwards into the furnace about  $\frac{5}{8}$  of an inch. This short tube is cast with a flanch, and it is fastened to the inside of the piece which constitutes the upper part of the body of the furnace, by means of three or four rivets. Two of these rivets are distinctly represented in the figure.

The lower part of the body of the furnace consists of the piece *F*, *G*, *H*, *I*, and it is fastened



to the upper part by means of rivets, two of which are seen at F. and at G. In one side of this lower part there is a circular hole at K, about  $1\frac{1}{4}$  inches in diameter, which serves for the admission of air, and which is furnished with a register stopper. The bottom of this furnace, instead of being made flat is spherical, projecting upwards; which form was chosen in order to prevent, as much as possible, the heat from the fire from being communicated downward. This furnace will require no handle, as its projecting brim will serve instead of one.

It will be observed, that all the pieces of which this furnace is composed, are of such forms that the moulds for casting them will readily deliver from the sand; and that circumstance will contribute greatly to the lowness of the price at which this most useful article of kitchen furniture may be afforded.

The perforated cast-iron bowl, A, which constitutes the fire-place, is not confined in its place, and its form and its position are such that its expansion with heat can do no injury to the outside of the furnace.

When the two pieces which form the body of the furnace are fastened together, their joinings may be made tight with cement.

A little fine sand should be put into the hollow rim, *a, b*, of the furnace, in order that it may be perfectly closed above by the lower end of the hollow cylinder of its boiler; and a little sand or ashes may be thrown upon the bottom of the cir-



cular cavity *o, p*, into which the smoke descends, before it goes off by the tube *L*, into the chimney. This last precaution will prevent the air from making its way upwards from the ash-pit directly into the cavity *o, p*, occupied by the smoke, without passing through the fire-place.

The register stopper to the opening *K*, into the ash-pit, may be constructed on the same principle as that of the blow-pipe of a roaster. One of these stoppers is represented on a large scale in the figure 17, at the end of the second part of this (tenth) Essay; or what will be still more simple, and quite as good, the admission of the air may be regulated by a register like that represented in the preceding figure, No. 61.

This portable kitchen furnace will answer a variety of useful purposes; and, if I am not much mistaken, it will come into very general use. It is cheap and durable, and not liable to be broken by accidents, or put out of order; and it is equally well adapted for every kind of fuel. No particular care or attention is required in the management of it, and it is well calculated for confining heat, and directing it.

As the fire-place belonging to this furnace is nearly insulated, and as it contains but a small quantity of matter to be heated, a fire is easily and expeditiously kindled in it; and the fuel burns in it under the most favourable circumstance.

It will be found extremely useful for boiling a tea-kettle, especially in summer; when a fire in

the grate is not wanted for other purposes; and, when the tea-kettle is constructed on the principles that will presently be described, a very small quantity indeed of fuel will suffice.

But the most important use to which these portable furnaces can be applied, is, most undoubtedly, for cooking for POOR FAMILIES. I have hinted at the probable utility of a contrivance of this kind in some of my former publications, but since that time I have had opportunities of examining the subject more attentively, and of ascertaining the fact by the test of actual experiment.

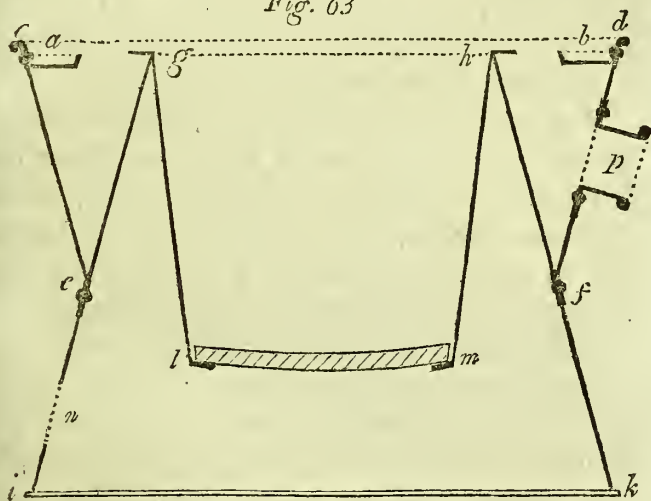
As the subject strikes me as being of no small degree of importance, I shall make no apology for enlarging on it, and giving the *most particular account* of several kinds of *portable kitchen furnaces*.

That just described (of cast-iron) is, it is true, as perfect in all respects as I have been able to make it, and will probably be found to be quite as economical and as useful as any that I shall describe; but cast-iron is not every where to be found, and even where foundries are established for casting it, moulds must be provided, and these are expensive, and not easy to be had. As it is probable that some persons may be desirous of being provided with portable furnaces of this kind, who may not have it in their power to procure them of cast-iron, I shall now shew how they may be constructed (by any common workman) of sheet-iron, and also how they may be made of earthen-ware.

*Of small Portable Kitchen Furnaces constructed of  
sheet-iron.*

The following figure represents a vertical section of one of these furnaces, drawn to a scale of 4 inches to the inch.

Fig. 63



The construction of this furnace will be easily understood from this figure. The circular hollow horizontal rim *a, b*, which I shall call the *sand rim*, is  $8\frac{8}{16}$  inches in diameter within, and  $12\frac{4}{16}$  inches in diameter without. Its width at its bottom, which is flat, is just 1 inch. Its sides are sloping, and of different heights; that which is towards the center of the furnace is  $\frac{3}{4}$  of an inch high; but the side which is outwards is  $\frac{1}{2}$  an inch in height.

The sand-rim is confined and supported in its place by being fastened by means of rivets or

otherwise, to an inverted hollow truncated cone, *c, d, e, f*, which forms the upper part of the body of the furnace. This inverted cone, which is turned over a strong circular iron wire at its upper edge, *c, d*, is  $12 \frac{4}{10}$  inches in diameter above, measured within the wire, and  $5 \frac{4}{10}$  inches in height, measured from *c* to *e*, or from *d* to *f*; and is  $9 \frac{4}{10}$  inches in diameter, from *e* to *f*, where it is fastened to the erect hollow truncated cone, *g, h, i, k*.

This last mentioned erect cone, which is closed below by a circular plate of sheet-iron, forms the lower part of the body of the furnace: it is 7 inches in diameter above, 12 inches in diameter below, and its perpendicular height is just 9 inches. Its sloping side, *g, i*, measures about  $9 \frac{6}{10}$  inches.

The *fire-place* of this little portable furnace is an inverted hollow truncated cone, *g, h, l, m*, which is 7 inches in diameter above, at *g, h*; and  $5 \frac{1}{2}$  inches in diameter below, at *l, m*; and its length is  $6 \frac{1}{2}$  inches, measured from *g* to *m*. This conical fire-place has a flat rim above, which is  $\frac{1}{2}$  an inch wide, and turned outwards; and another below of equal width, which is turned inwards. The first serves to suspend it in its place; the second serves to support its circular grate, on which the fuel burns.

The air is admitted into the fire-place through a hole, *n*, about  $1 \frac{1}{4}$  inches in diameter, in the side of the furnace. This aperture must be furnished with a register similar to that shewn in the figure 61.

The provision for carrying off the smoke is similar

lar in all respects to that used in the portable furnace above described, constructed of cast-iron; and it will easily be understood, from a bare inspection of the figure (63), without any farther explanation.

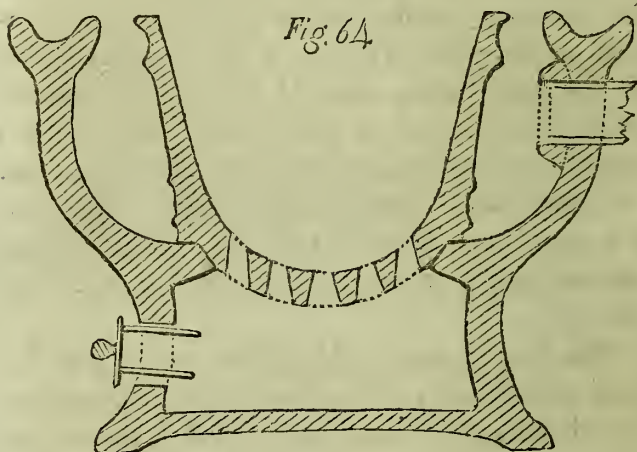
Having shewn how this portable kitchen furnace may be constructed of cast-iron, and also how it may be made of sheet-iron, I shall now shew how it may be made, partly of cast-iron, and partly of sheet-iron. A fire-place of cast-iron, like that represented in the 62d figure, may be used in a furnace of sheet-iron; but when this is done, the fire-place must be cast with a projecting rim above, in order that it may be suspended in its place. The sand-rim may likewise be of cast-iron, and it may be fastened to the inverted hollow cone, *c, d, e, f*, by rivets.

The short tube *p*, which serves to support the tube which carries off the smoke, may also be made of cast-iron, and it may be fastened to the outside of the furnace by three rivets. As it may be made of such a form that its mould will deliver from the sand, it will cost less when made of cast-iron than when made of sheet-iron; and it will have another advantage: its form on the inside will be more regular, and it will be better adapted on that account for receiving the end of the tube, which it is designed to receive. Its length need not exceed 1 inch or  $1\frac{1}{2}$  inches, and its internal diameter may be about  $1\frac{1}{2}$  inches at its projecting extremity, and something less at its other end, where it joins the side of the furnace.



*Of small Portable Kitchen Furnaces constructed of Earthen-ware.*

The following figure represents a furnace of this kind (of earthen-ware) destined for heating boilers of the same kind, and of the same dimension as those proper to be used with the two (iron) furnaces last described :



This figure represents a vertical section of the furnace, drawn to a scale of four inches to the inch ; and it gives an idea so clear and satisfactory of the form of this furnace, that a detailed description of it would be superfluous.

The fire-place is distinct from the body of the furnace, and its form and position are such that it cannot crack and injure the body of the furnace by its expansion with heat. It resembles very much the cast-iron fire-place just described, and the same principles

principles regulated the contrivance of both of them. It should be bound round with iron wire, in order to hold it together, in case it should crack with the heat of the fire. Two places for the wire, one near its brim, and the other lower down, are shewn in the figure.

The aperture by which the air enters the ash-pit is closed by a register-stopper, represented in the figure, or a conical stopper of earthen-ware may be used for that purpose.

If such earthen-ware is used in constructing these small portable furnaces, as are known to stand fire well, there is no doubt but these furnaces may, with proper usage, be made to last a great while ;—and for confining heat, they are certainly preferable to all others.

The portable kitchen furnaces in China, are all constructed of earthen-ware ; and no people ever carried those inventions which are most generally useful in common life to higher perfection than the Chinese. They, and they only, of all the nations of whom we have any authentic accounts, seem to have had a just idea of the infinite importance of those improvements which are calculated to promote the comforts of the lowest classes of society.

What immortal glory might any European nation obtain by following this wise example !

The Emperor of China, the greatest monarch in the world, who rules over one full *third part* of the inhabitants of this globe, condescends to hold  
the

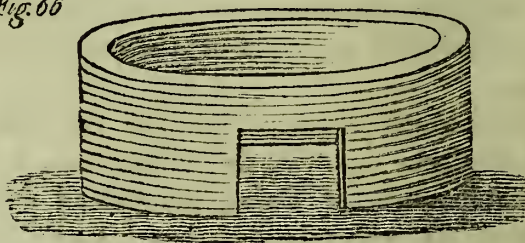
*the plough* himself one day in every year.—This he does, no doubt to shew to those whose example never can fail to influence the great bulk of mankind, how important that art is by means of which food is provided.

Let those reflect seriously on this illustrious example of provident and benevolent attention to the wants of mankind, who are disposed to consider the domestic arrangements of the labouring classes as a subject too low and vulgar for their notice.

If attention to the art by which food is provided be not beneath the dignity of a Great Monarch ; that art by which food is prepared for use, and by which it may be greatly *economized*, cannot possibly be unworthy of the attention of those who take pleasure in promoting the happiness of mankind.

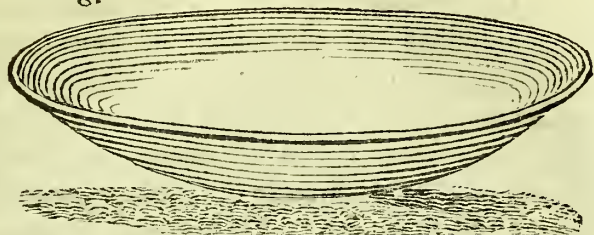
As the implements used in China for cooking are uncommonly simple, it may perhaps be amusing to the reader to be made acquainted with them. They consist of the two articles represented below :

*Fig. 65*



*Fig.*

Fig. 66



This figure 65, which is made of earthen-ware, is the fire-place, which is set down on the ground. The shallow pan represented by the figure 66, is of cast-iron, and serves for every process of Chinese cookery. It is cast very thin, and if by any accident a hole is made in it, their itinerant tinkers mend it, by filling up the hole, which they do with so much dexterity that scarcely a mark is left behind.

When the dinner consists of several dishes they are all cooked in this pan, one after the other, and those which are done first are kept warm till they are sent to table.

I leave it to the ingenuity of Europeans to appreciate these specimens of Chinese industry.

But to return from this digression, to our portable kitchen furnaces—Although these furnaces are peculiarly adapted for heating boilers and stew-pans that are *armed*, yet boilers on the common construction, or such as are not suspended in cylinders, may easily be used with them. When this is to be done, a detached hollow cylinder or cone must be used, in the manner described in the preceding

preceding chapter. and represented in the figure 50. This cylinder or cone (which may be constructed either of sheet-iron, of cast-iron, or of earthen-ware) must be about an inch higher than the boiler is deep, with which it is to be used ; and just so wide above as to admit the boiler to be suspended in it by its circular rim. Its diameter below must be such as to fit the sand rim, in which it must stand, when it is used,



## CHAP. XII.

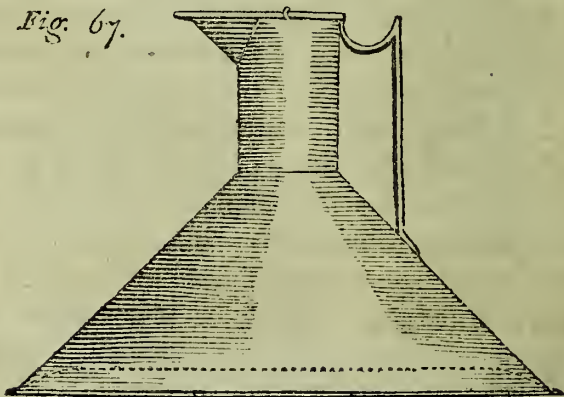
*Of the construction of TEA-KETTLES, proper to be used with Register-Stoves, and portable Kitchen Furnaces.—These utensils may be constructed of tin, and ornamented by japanning and gilding—When they are properly constructed and managed, they may be heated over a small portable furnace in a very short time, and with a surprizingly small quantity of fuel.—Descriptions of four of these tea-kettles of different forms and sizes.—Description of several very SIMPLE and CHEAP STEW-PANS for portable Furnaces.—Description of a STEW-PAN of EARTHEN-WARE, on an improved construction.—This will probably turn out to be a most useful utensil for cooking with portable furnaces.*

**A**S Tea-kettles are so much used in this country, and as they occasion so great a consumption of fuel (a large fire being frequently made in a grate, or kitchen-range, morning and evening, for the sole purpose of heating a few pints of water to make tea) the saving of this unnecessary trouble and expence is an object deserving of attention. And in doing this it will be possible to improve very essentially the forms of tea-kettles in several respects, and at the same time to render their external appearance more neat and cleanly. If the forms I shall recommend should not happen to please at first sight, it should be remembered that  
utility,

utility, cleanliness, and wholesomeness are objects of more importance in cases like that in question than mere elegance of form—and after all, I am not sure whether the forms I shall propose are not in reality quite as elegant as those with which they will be compared. They will, no doubt, at first sight appear uncouth to many persons, but the eye will soon become accustomed to them; and their superior cheapness, cleanliness, and usefulness, will in the end procure them that preference which they deserve. They may, no doubt, be constructed of the most elegant forms, on the principles I shall recommend, but I shall confine my descriptions to such forms as are most simple, and of the easiest and least expensive construction, leaving it to those to beautify the article whose business and interest it is to set off their goods to the best advantage.

The following figure represents a tea-kettle of the simplest form, suited to a register kitchen stove, or to a portable furnace, such as has just been described:

*Fig. 67.*



This

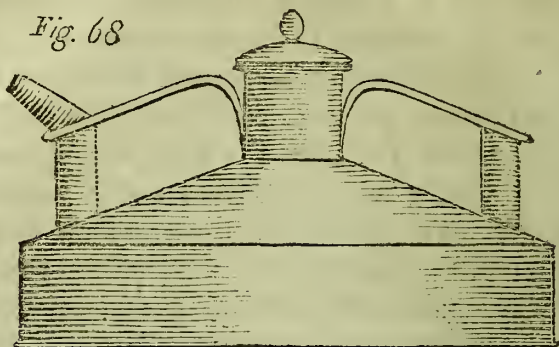
This tea-kettle is constructed of tin, and it may be japanned on the outside to prevent its rusting, and to give it an elegant and cleanly appearance. Its bottom, which is 11 inches in diameter, is not flat, but it is raised up about half an inch in the manner pointed out by a dotted line. The body of this tea-kettle is of a conical form, ending above in a cylinder, 3 inches in length and 2 inches in diameter. The spout, which resembles that of a coffee-pot, is situated at the top of this cylinder, and it has a flat cover, fastened by a hinge, which prevents dust or soot from falling into it when it stands on the hearth. When this tea-kettle is put over the fire it should not be filled higher than to the top of the cone, or lower end of the cylinder, otherwise it will be liable to boil over. The kettle, so filled, will contain 4 pints of water, and if it be heated over one of the small portable furnaces described in the foregoing chapter, it may be made to boil in about 10 minutes, with  $6\frac{1}{2}$  oz. of dry wood, which at the price at which wood is commonly sold in London, would cost  $\frac{3}{8}$  of a farthing.\*

The tea-kettle represented by the following figure is rather more complicated, but still its form is more simple, and more advantageous in several respects, than those which are in common use, and it is well adapted for the fire-places we

\* One pint of water only being put into this tea-kettle, over a very small wood fire, made in the portable furnace represented in the foregoing figure 63 (see page 293) it was heated and made to boil in *two minutes and an half*.

have recommended. It is drawn to a scale of 4 inches to the inch :

*Fig. 68*



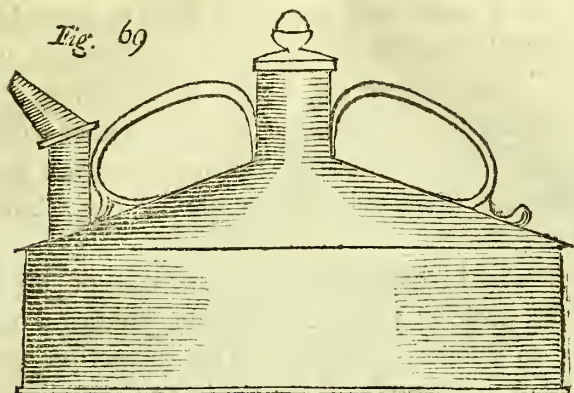
This kettle has two handles, each of which is supported on the outside, or near the circumference of the kettle, by a small vertical tube  $\frac{3}{4}$  of an inch in diameter, and  $1\frac{3}{4}$  inches in height. That on the left hand is open, and forms a part of the spout; but that on the right hand is closed at both ends. The bottom of this kettle, also the bottoms of those represented in the two following figures, like that of the last (figure 67) is not flat, but is raised up about half an inch above the level of the lower part of the cylindrical sides of the kettle.

This kettle holds about 3 quarts of water, which can be made to boil with the combustion of  $9\frac{1}{2}$  oz. of wood.

The following kettle holds about 1 gallon, and may be made to boil with  $\frac{3}{4}$  lbs. of wood: which would cost just  $\frac{1}{4}$  of a farthing.

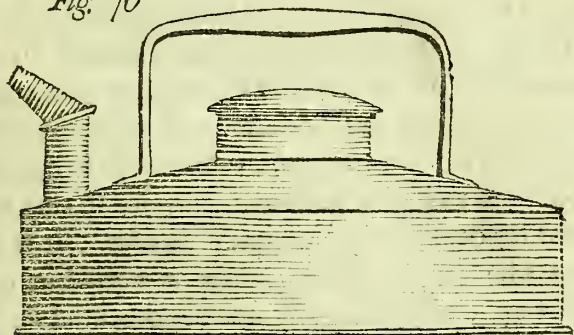


Fig. 69



The following kettle is not essentially different from those two last described, except in the form of its handle. It holds about 3 quarts.

Fig. 70



The cylindrical opening of this kettle above, where the water is introduced, is considerably wider than those in the two foregoing figures. It was made wider, because it was necessary to make it lower, in order to make room for the hand without raising the handle too high. When this part of a tea-



kettle is made very narrow it must be made high, to afford room for the expansion of the water with heat, and prevent the kettle from boiling over. These kettles should never be filled higher than to the level of the lower part of this cylindrical space, otherwise there will be danger of their boiling over\*.

It will be observed that the cover of this tea-kettle projects a little beyond the cylindrical opening to which it belongs. This projection serves instead of a handle in removing and replacing the cover. The cover of a tea-kettle is usually furnished with a knob for that purpose; but these knobs are in the way when the kettle is lifted up by its handle, unless the handle be made much higher than otherwise would be sufficient.

It has, no doubt, already been remarked by the reader, that all the tea-kettles here recommended are of forms that are perfectly easy to be executed in tin. There are several reasons which have induced me to give a decided preference to that material for constructing culinary utensils. It is not only wholesome—which copper is not—but it is also very cheap, and easy to be procured in all places, and it is easily worked: it is moreover light and strong, and not liable to be injured by accidents; and if measures be taken to prevent the effects of rust, it is very durable.

\* I find by experiments made since the above was written, that tea-kettles of this kind should never be filled above two-thirds full, otherwise they will be very apt to boil over.

The four tea-kettles represented in the four last figures are all particularly designed to be used with the portable furnaces described in the last chapter; and for that purpose they are well calculated, although they are not suspended in cylinders. They may likewise be used with the register kitchen stoves described in the tenth chapter of this Essay. As their bottoms are raised up, and as their diameters are such that their conical or vertical sides enter into, and fit the sand-rims of those furnaces and stoves, the heat is effectually confined under them, and their outsides not being exposed either to flame or to smoke, may be japanned, and they may easily be kept so clean as to be fit to be placed upon a table, over a lamp, or upon a heater, placed in a shallow dish of china or earthenware. They are even capable of being elegantly ornamented by gilding or painting, or both.

They are likewise well calculated for being heated by a lamp; and if an argand's lamp be used for that purpose, they may be made to boil in a short time, and at a small expence. Placed on a handsome tripod, on a table, with an elegant argand's lamp under it, one of these kettles, handsomely ornamented by japanning and gilding, would make no mean appearance, and would cost much less than the commonest tea-urn that could be bought.

But it is not solely for making tea that these kettles will be found useful; they will answer perfectly well for boiling water for many other purposes; and if portable kitchen furnaces should come into use, boiling hot water will often be want-

ed for filling sauce-pans and stew-pans; and no utensil can be better contrived for heating and boiling water over a portable kitchen furnace than these kettles.

In constructing them care should be taken to fill all their seams well with solder, which, by covering the naked edges of the iron, will contribute more than any thing to the prevention of rust, and the durability of the article; and they should likewise be well japanned on the outside in every part except the bottom, which should not be japanned.

The reason why I have not made these tin tea-kettles double, is this: tea-kettles are commonly used merely for *making water boil*, which, with the kettles here recommended, can be done *in a very short time*, consequently much heat cannot possibly be lost during that process, in consequence of the top and sides of the kettle being exposed naked to the cold air of the atmosphere. Were these utensils designed for *keeping water boiling hot* a great length of time, the case would be very different, and then it might be well worth while to make them double, in order more effectually to confine the heat in them.

The *saving of time* in making them boil, by making them double, would be very trifling indeed, for till the water has become very hot, there is but little loss of heat through the sides and top of the kettle; the communication of heat being rapid in proportion as the temperature of the hot body is high, compared with that of the colder body into which the heat passes.

If

If a tea-kettle, filled with water at the temperature of the atmosphere at the time, on being put over a fire, be brought to boil in 10 minutes, it will, during that time, have lost only half as much heat as it will lose in the next ten minutes, if it be kept boiling hot during that time.

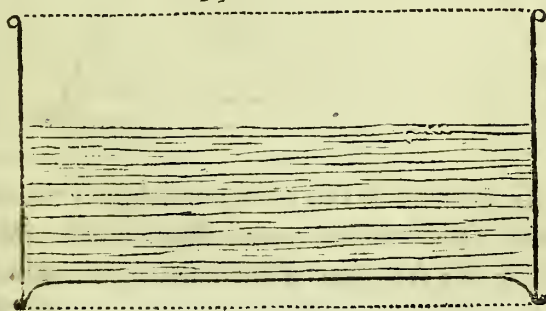
All these kettles are of such forms as will render it very easy to cover them, should it be thought advisable to make them double; and by covering them with plated or gilt copper, they may be made very elegant at a small expence.

*Of the construction of cheap Boilers and Stew-pans to be used with small Portable Kitchen Furnaces.*

The best boilers and stew-pans that can be used with these furnaces, are undoubtedly those which were described in the 10th chapter of this Essay, but utensils on a simpler construction may be made to answer very well, and may perhaps be preferred by many on account of their cheapness.

The following figure represents a vertical section of a stew-pan on a much more simple construction than any of those already described:

*Fig 71*

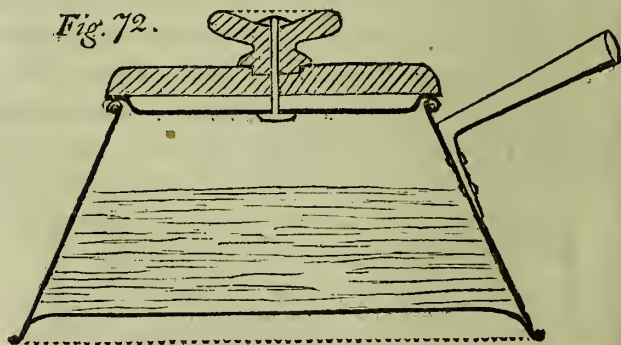




This stew-pan (which is drawn to a scale of four inches to the inch) being of a proper diameter below to fit the sand-rim of the portable furnace, and its bottom being raised up about half an inch, in order to allow its vertical sides to descend into that sand-rim, it is plain that it may be used with the furnace, in the same manner as the tea-kettles just described are used with it. It may likewise be used with the register-stoves described in the 10th chapter of this Essay.

In order that this stew-pan may the more easily be kept clean, the joinings of its bottom and sides should be well filled up on the inside with folder.

The following figure represents another, and smaller stew-pan, constructed on the same principles with that just described, and designed for the same use :



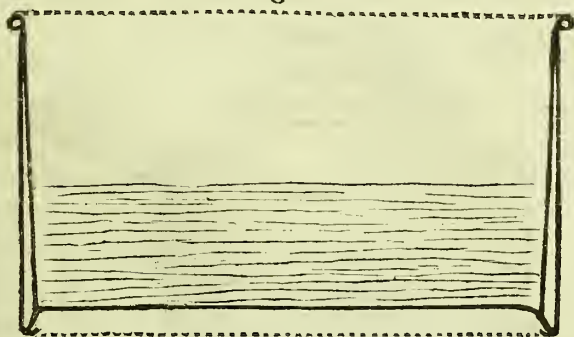
The diameter of this stew-pan below is the same as that of the last—this is necessary, in order that it may fit the sand-rim of the same register stove or portable



portable furnace—but its diameter above is much less; and it is also less deep, consequently its capacity is much smaller. The cover of this stew-pan is of wood lined with tin. It is in all respects like that represented by the figure 35 (see chapter VII. of this Essay, page 222). Both these stew-pans are supposed to be constructed of tin; but they might be made of tinned copper. The handle of the stew-pan represented by the figure 71, is omitted for want of room.

The following figure represents a vertical section of a double, or armed stew-pan, on a very simple construction:

*Fig. 73.*



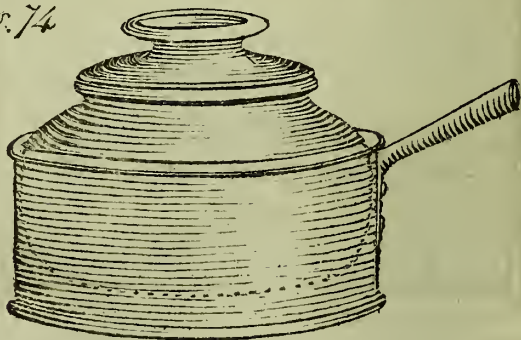
The stew-pan, (which is drawn to a scale of four inches to the inch) is supposed to be made of tin, and it is supposed to be turned over a wire at its brim. The cylinder by which it is surrounded is of sheet-iron, and the stew-pan and the cylinder

are fastened together by, the former being driven into the latter, with some degree of force, and sticking in it above, where they come into close contact. The lower edge of the cylinder being turned inwards forms a narrow rim, on which the lower end of the stew-pan rests.

*Of the construction of Stew-pans of EARTHEN-WARE and PORCELAIN, to be used with Register Stoves and Portable Kitchen Furnaces.*

The following figure shews how, by means of a hoop, or cylinder of sheet-iron, a stew-pan, or sauce-pan, of earthen-ware, or of porcelain, of a suitable form and size, may be fitted to be used with a register kitchen stove, or portable furnace.

*Fig. 74*



This figure is drawn to a scale of six inches to the inch. The form of the lower part of the stew-pan is pointed out by a dotted line. The top and the bottom of the cylinder of sheet-iron are both turned over circular iron wires. The handle of  
this

this stew-pan is of iron, and it is fixed to the cylinder by rivets. The stew-pan is firmly fastened to its metallic hoop or cylinder, first, by making this cylinder of a proper size to fit it; and secondly, by wedging it both above and below with very thin wedges, made of narrow pieces of sheet-iron, and by filling up the vacuities, above and below, with good cement.

The cover of this stew-pan, which is of earthenware (or porcelain) is made of a peculiar form. It has a kind of foot instead of a handle, which serves for supporting it when it is taken off from the stew-pan, and laid down in an inverted position. By means of this simple contrivance it is rendered less liable to be dirtied on the inside, and of communicating dirt to the victuals.

If an earthen stew-pan, of the form represented in this figure, be made of good materials, that is to say, of a proper mixture of the different earths, well worked, and if its bottom be made thin, and of equal thickness in every part of it that is exposed to the fire, there is little doubt, I think, of its standing the heat of a register stove, or of a small portable kitchen furnace; and if this should be the case, I should certainly never think of recommending any other kitchen utensils in preference to these.

It appears to me to be very probable that unglazed Wedgewood's ware would be as good a material as could be found for these stew-pans. The intelligent gentleman who directs Mr. Wedgewood's

wood's manufactory, caused several of them to be made, after drawings which I gave him, and those I found, upon trial, to answer very well.

If it should be found that kitchen utensils, constructed and fitted up, or mounted, on the principles here pointed out, should answer as well as there is reason to expect; as nothing would be easier than to make earthen boilers with *steam-rims*, and to form *steam-dishes* of earthen-ware to fit them; every utensil for cooking, by *boiling* and *stewing*, might be constructed of that most cleanly, most elegant, and most wholesome material—*earthen-ware*.

I hesitated a long time before I resolved to publish this last observation;—for however anxious I am to promote useful improvements, and especially such as tend to the preservation of health, and the increase of rational enjoyments, it always gives me pain when I recollect how impossible it is to introduce any thing new, however useful it may be to society at large, without occasioning a temporary loss or inconvenience to some certain individuals, whose interest it is to preserve the state of things *actually existing*.

It certainly requires some courage, and perhaps no small share of enthusiasm, to stand forth the voluntary champion of the public good:—but this is a melancholy reflection, on which I never suffer my mind to dwell. There is no saying what the consequences might be were we always to set down before we engage in a laudable undertaking, and  
meditat

meditate profoundly upon all the dangers and difficulties that are inseparably connected with it. The most ardent zeal might perhaps be damped, and the warmest benevolence discouraged.

But the enterprising seldom regard dangers, and are never dismayed by them ; and they consider difficulties but to see how they are to be overcome. To them *activity* alone is life—and their glorious reward, the consciousness of having done well. *Their* sleep is sweet when the labours of the day are over ; and they await, with placid composure, that rest, which is to put a final end, to all their labours, and to all their sufferings.



## C H A P. XIII.

*Of cheap Kitchen Utenfils for the use of the Poor.—The condition of the lower classes of Society cannot be improved without the friendly assistance of the Rich.—They must be TAUGHT economy, and they cannot be instructed by books, for they have not leisure to read.—Advice intended for their good must be addressed to their benevolent and more wealthy neighbours.—An account of the Kitchen Utenfils of the poor itinerant Families that trade between Bavaria and the Tyrol.—These utenfils were adopted by the Bavarian Soldiers.—An account of some attempts that were made to improve them.—Description of a very simple closed Fire-Place constructed with seven loose Bricks—How this Fire-Place may be improved by using three Bricks more, and a few Pebbles.—Description of a very useful PORTABLE KITCHEN BOILER, of cast-iron, suitable for a small family.—An account of a very simple method of COOKING WITH STEAM, on the cover of this Boiler.—Description of a STEAM-DISH of earthenware, or of cast-iron, to be used with this Boiler.—Description of a Boiler still more simple in its construction, proper to be used with a small Portable Kitchen Furnace.—The cooking Apparatus here recommended for the use of the Poor, may, with a small addition, be rendered serviceable for warming their dwellings in cold weather.*

**A**MONGST the great variety of enjoyments which riches put within the reach of persons of fortune

tune and education, there is none more delightful than that which results from doing good to those from whom no return can be expected; or none but gratitude, respect, and attachment. What exquisite pleasure then must it afford, to collect the scattered rays of useful science, and direct them, *united*, to objects of general utility!—to throw them in a broad beam on the cold and dreary habitations of the poor! spreading cheerfulness and comfort all around!

Is it not possible to draw off the attention of the rich from trifling and unprofitable amusements, and engage them in pursuits in which their own happiness and reputation, and the public prosperity, are so intimately connected? What a wonderful change in the state of society might, in a short time, be effected by their *united efforts*!

It is hardly possible for the condition of the lower classes of society to be essentially improved without that kind and friendly assistance which none can afford them but the rich and the benevolent. They must be *taught*, and who is there, in whom they have confidence, that will take the trouble to instruct them? They cannot learn from books, for they have not time to read: and if they had, how few of them would be able, from a written description, to comprehend what they ought to know! If I write for their instruction, it is to the rich that I must address myself; and if I am not able to engage *them* to assist me, all my labours will be in vain. But to proceed:

In

In contriving kitchen utensils for cottagers, two objects must frequently be had in view; viz. the cooking of victuals, and the warming of the habitation; and as these objects require very different mechanical arrangements, some address will be necessary in combining them.

Another point to which the utmost attention must be paid, is to avoid all complicated and expensive machinery. Instruments for general use should be as simple as possible; and such as are destined for the use of those who must earn their daily bread by their labour, should be cheap, durable, and not liable to accidents, or to be often in want of repairs.

As food is more indispensably necessary than a warm room; and as the most common process of cookery is boiling, I shall first show how that process may be performed in the most economical manner possible; and shall then point out the means that may be used for rendering the kitchen-fire useful in warming the room in which cookery is carried on.

One of the cheapest utensils for cooking, for a family, that ever was contrived, is, I verily believe, that used by the itinerant poor families that trade between Bavaria and the Tyrol, bringing raisins, lemons, &c. from the south side of the mountains (which they transport in light carts drawn by themselves) and carrying back earthenware.

As these poor people have no fixed abode, and

never stop at an inn, or other public-house, but, like the gipsies in this country, sleep in empty barns, and under the hedges by the road side, they carry with them in their cart all that they possess; and among the rest the whole of their kitchen furniture, which consists of *one single article*—a deep frying-pan of hammered iron, with a short iron handle.

In this they bake their cakes—boil their brown soup—make their hasty pudding—stew their greens,—fry their meat—and in short perform every process of their cookery; and when their victuals are done, their boiler serves them for a dish, which, being placed on the ground, the family sit round it, each individual, capable of feeding himself, being provided with a wooden spoon.

This is precisely the same kind of kitchen utensil as that used by the Bavarian wood-cutters, when they go into the mountains to fell wood; (see Essay III. page 295, vol. I.) and it is likewise used by many poor families in the Tyrol and in Bavaria.

These broad stew-pans—with the addition of a tripod of hammered iron—were adopted, many years ago, in Bavaria, for the use of the soldiers in barracks; and they still continue to be used by them: some successful attempts to improve them, have, however, lately been made, and it was the experiments which led to those improvements, that first induced me to turn my attention to this useful article of kitchen furniture.

Before



Before I proceed any farther in my account of these shallow pans, and of the improvements of which they have been found to be capable, it may perhaps be proper to give an account of the manner in which they are constructed, and of the price at which they are sold.

All those which are used in Bavaria come from the Tyrol, or from Styria, where there are considerable manufactories of them; and they are sold at Munich, by wholesale, at 22 creutzers (about  $7\frac{1}{2}d.$  sterling) the pound, Bavarian weight, which is at the rate of 6 *d.* sterling per lb. avoirdupois weight.

One of these pans of large dimensions, namely, 18 inches in diameter above, or at its brim, 15 inches in diameter below, and 4 inches deep, bought at an ironmonger's shop at Munich, cost me three shillings sterling.

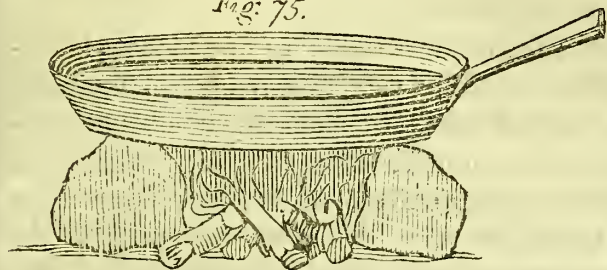
In manufacturing these pans, five of them, one placed within the other, are brought under the hammer at the same time; and, in being hammered out, and brought to their proper form and thickness, they are frequently heated red hot. When they come from the hammer they are carried to the lathe, and are turned on the inside, and made clean and bright, and their edges are turned and made even. They are then packed up, one within the other, or, in nests (as these parcels are called) and are sold by weight.

The following figure represents one of these pans in its most simple state, placed on three stones, over a



fire made with small sticks of wood, on the ground, in the open air.

*Fig. 75.*

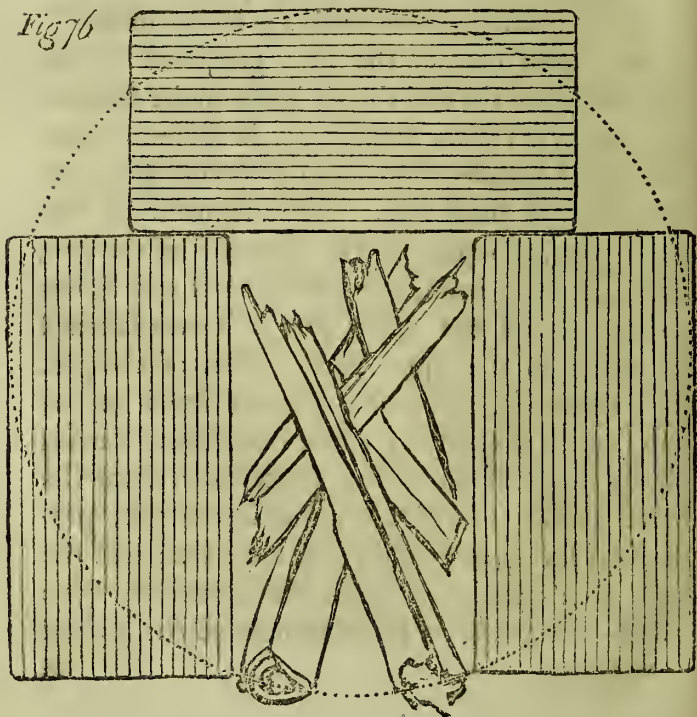


The pan used by the Bavarian soldiers, which, as I just observed, is placed on a tripod, or trivet, of iron, is about 20 inches in diameter above, 16 inches in diameter below, and  $4\frac{1}{2}$  inches deep.

As a great part of the heat generated in the combustion of the fuel that is burnt under this pan escaped by its sides, to prevent, in some measure, this loss, I inclosed the pan in a circular hoop, or cylinder, of sheet-iron. The diameter of this hoop was just equal to the diameter of the pan, above, or at its brim, and its height or width, was six inches, and the upper part of it was fastened by rivets to the upper part or brim of the pan. This alteration, and a double cover fitted to the pan, which prevented the heat from being carried off by the cold air of the atmosphere, from the broad surface of the hot liquid in the pan, produced a saving of considerably more than half the fuel, even when this fuel—which was dry pine wood—was burnt on the hearth, or on the ground

in the open air, and no means were used for confining the heat on either side. But the saving was still greater when the fire was made in a closed fire-place.

For a pan of this kind of 14 or 15 inches in diameter at its brim, a very good temporary fire-place may be constructed in a moment, and almost without either trouble or expence, merely with seven common bricks: Six of them, laid down upon the hearth, in pairs, one upon the other, in the manner represented in the following figure, form the fire-place; and the seventh, placed edge-wise, serves as a sliding door, to close this fire-place in front, more or less, as shall be found best.

*Fig 76*

This

This little fire-place, which is better calculated for wood, or for turf, than for coals, is represented filled with fire-wood ready to be kindled, and a dotted circular line shews where the bottom of the circular hoop of sheet-iron (in which the pan is suspended) should be set down upon the top of the three bricks which are uppermost.

If, in constructing this fire-place, its walls be made higher, by using nine bricks, instead of six, (laid down flat upon one another, by threes) and if a few loose pebbles, or stones of any kind, about as large as hen's-eggs, be put into it, under the fuel, these additions will improve it considerably. The fuel being laid upon these pebbles, instead of lying on the hearth, or on the ground, the air necessary for its combustion will the more readily get under it; which will cause the fire to burn brighter, and more heat to be generated.

These small stones will likewise serve other useful purposes. They will grow very hot, and when they are so they will increase the violence of the combustion, and the intensity of the heat; and even after the fuel is all consumed, they will still be of use, by giving off gradually to the pan, the heat which they will have imbibed.

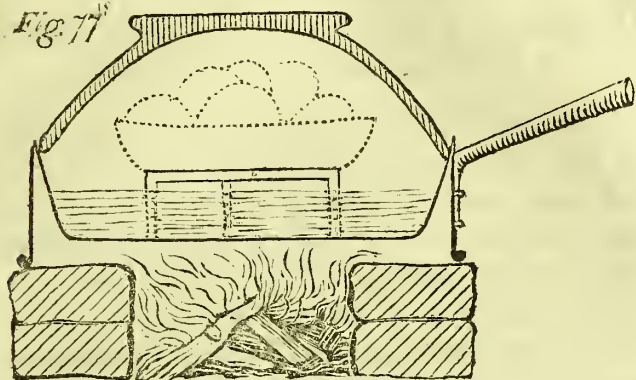
Savages, who have few implements of cookery, make great use of heated stones in preparing their food; and civilized nations would do wisely to avail themselves, oftener than they do, of *their* ingenious contrivances.

I have already mentioned, that a considerable saving of fuel was made in consequence of furnishing the broad and shallow boilers of the Bavarian soldiers with double covers ; but for boilers of this kind, that are destined for poor families, I would recommend wooden or earthen dishes, turned upside down, instead of these double covers ; which dishes may also be used for serving up the victuals after it is cooked. By this contrivance an article necessary in house-keeping will be made to serve two purposes ; and besides this advantage, as a deep bowl, or platter, turned upside down, over the shallow boiler, will leave a considerable space above the level of the boiler, which, as steam is lighter than air, will always be filled with hot steam, when the water in the shallow pan is boiling, notwithstanding that the joinings of this inverted dish with the rim of the pan will not be steam-tight, a piece of meat much larger than could be covered by the water in this shallow pan might be cooked in it, or potatoes or greens, placed above the surface of the water in the pan, might be cooked in steam.

The following figure, which represents a vertical section of one of these shallow iron boilers, 14 inches in diameter above, surrounded by a cylindrical hoop of sheet iron, for confining the heat, and covered by an inverted earthen dish, will give a clear idea of the proposed arrangement.



*Fig. 77*



The fire-place represented in this figure, is that shewn in the preceding figure (76) and is constructed of six loose bricks. The brick which occasionally serves to close the opening into the fire-place in front, is not shewn.

A shallow dish is represented (by dotted lines) standing on a small tripod above the surface of the water in the boiler, and filled with potatoes, which are supposed to be boiled in steam.

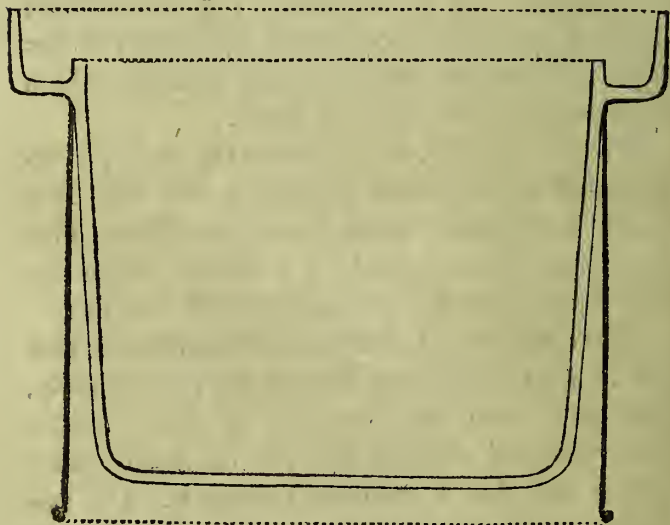
The earthen dish, which covers the boiler, is represented with a small projection, like the foot which is frequently given to earthen dishes: This projection serves instead of a handle, when the dish is placed upon, or removed from the boiler.

This I believe to be the cheapest contrivance that can be used for cooking victuals for a poor family, especially when the durability of the utensil is taken into the account, and also the small quantity of fuel that is required to heat it. The following contrivance will however be found more convenient, and not much more expensive :



*Description of a very useful portable Kitchen Boiler,  
of cast-iron, suitable for a small family.*

The form of this boiler is such that it may easily be cast, and consequently it may be afforded at a low price; and it is equally well calculated to be used with one of the small temporary fire-places just described, constructed with six, or with nine loose bricks, or to be heated over one of the small portable kitchen furnaces, of which an account has been given in Chap. XI. It may be made of any dimensions, but the size I would recommend for a small poor family is that indicated by the following figure, which is drawn to a scale of four inches to the inch.

*Fig. 78*

This

This boiler is  $10 \frac{1}{2}$  inches in diameter above, on the inside of the steam rim ;  $9 \frac{1}{2}$  inches in diameter below, and  $8 \frac{1}{2}$  deep, measured from the top of the inside of the steam rim ; consequently it will hold about 3 gallons. Its greatest diameter at its brim is  $13 \frac{1}{2}$  inches, and total height to the top of its steam rim is  $9 \frac{1}{4}$  inches.

The hollow cylinder of sheet-iron in which this boiler is suspended, and which confines the heat by defending its sides from the cold air of the atmosphere, is  $8 \frac{1}{2}$  inches high, and just 11 inches in diameter.

When this boiler is used for preparing only one dish of victuals, or for cooking several things that may, without inconvenience, be all boiled together in the same water, it may be covered with the cover represented in the following figure.

*Fig. 79.*



This cover is composed of one piece of cast-iron, covered above with a flat circular piece of wood, which serves for confining the heat. The wood is fastened to the iron by means of a strong wood screw, with a flat square head, which passes through a hole in the centre of the piece of cast-iron.

The handle of this cover must project on one side, and must be fastened to the metal and not to the wood. A piece of it is seen, (at *a.*) in the figure. It may either be cast with the cover, or it may be of wrought iron, and fastened to it by rivets.

The figure, which is a vertical section of the cover, shews the form of it distinctly, and it will be perceived that the piece of cast-iron is of a shape which renders it easy to be moulded and cast. The two small projections on the right and left of the hole in the center of the cover are sections of a circular projection, about  $\frac{2}{8}$  of an inch in height, which, as will be seen presently, is designed to serve a particular purpose. In the circumference of this horizontal projecting ring there are three equi-distant projecting blunt points, each about  $\frac{3}{16}$  of an inch high above the level of the upper flat surface of the cover, or about  $\frac{1}{8}$  of an inch higher than the ring from the upper part of which they project. These three points serve for supporting a shallow dish, in which vegetables or any other kind of victuals is put in order to its being cooked in steam.

*Of the manner of using this simple apparatus for cooking with Steam.*

This may easily be done in the following manner: The flat circular piece of wood belonging to the cover of this boiler, being removed, and the

(cast-iron) cover being put down upon the boiler, a shallow dish, about 2 inches less in diameter than the cover, at its brim, or upper projecting rim, containing the victuals to be cooked in steam, is to be set down upon the cover, just in the centre of it, and an inverted earthen pot, or any other vessel of a form and size proper for that use, being put over it, the steam from the boiler passing up through the hole in the centre of the cover, will find its way under the shallow dish, and passing upwards by the sides of this dish, will enter the inverted earthen-pot, and, expelling the air, will take its place, and the victuals in the dish will be surrounded on every side by hot steam.

Instead of an earthen-pot, an inverted glass-bell may be used for covering the victuals in the shallow dish, which will not only render the experiment more striking, and more amusing, but will also, in some respects, be more convenient ; for as the process that is going on may be seen distinctly through the glass, a judgment may, in many cases, be formed, from the *appearance* of the victuals, when they are sufficiently done, without removing this vessel, by which the steam is confined.

I would not, however, recommend glass vessels for common use, as they would be too expensive for poor families, and too liable to be broken. For *them*, a pot, of the commonest earthen-ware, or a small wooden-tub, would be much more proper.

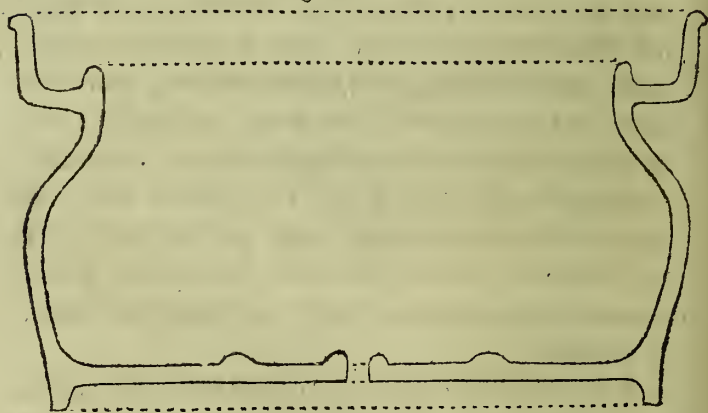
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But for those who can afford the expence, and who find amusement in experiments of this kind, the glass-bell will be preferable to an opaque vessel.

The manner in which this simple apparatus for cooking with steam is to be arranged, will be so easily understood from what has been said, that a figure can hardly be necessary to form a clear and satisfactory idea of it. I shall therefore now proceed to a description of another method of cooking with steam with these small portable kitchen boilers.

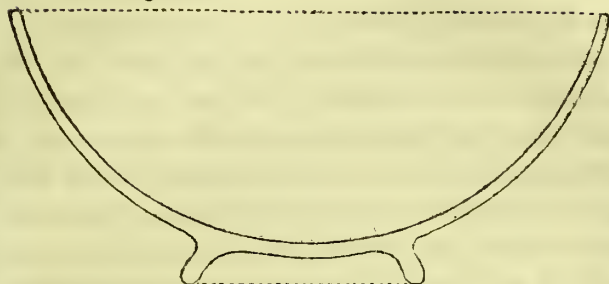
The following figure, which is drawn to a scale of four inches to the inch, represents a vertical section of a steam-dish of earthenware, proper to be used with the boiler represented by the figure 78 :

*Fig. 80*



The following figure represents a vertical section of an earthen bowl, which, being inverted, may be used occasionally as a cover for the steam-dish represented above, or as a cover for the boiler :



*Fig. 81*

When this dish is not in use as a cover for the steam-dish or the boiler, it may be made use of for other purposes. It may, for instance, serve for bringing the soup, or any other kind of food, upon the table, or for containing any thing that is to be put away. In short, it may be employed for any purpose for which any other earthen bowl of the same form and dimensions would be useful.

In like manner the steam-dish may be made use of for many other purposes besides cooking with steam.

This steam-dish, and the bowl which serves as a cover to it, may both be made of cast-iron; but when this is done, they should be tinned on the inside, and japanned on the outside, to give them a neat and cleanly appearance, and prevent their rusting. They may likewise be made of pewter; or by changing their forms a little they may be made of tin. The choice of the material to be employed in constructing them must, in each case, be determined by circumstances.

The

The inverted bowl which covers the steam-dish may be used likewise for covering the boiler, when the steam-dish is not in use :—or, the cover of the boiler which is represented by the figure 79, may be made use of, instead of the inverted bowl, for covering the steam-dish, and the bowl may be omitted altogether. One principal reason why I proposed this bowl was, to show how, by a little contrivance, an article useful in housekeeping might, without any inconvenience or impropriety, be made to serve different purposes.

It is the interest of so many persons to *increase* as much as possible the number of articles used in housekeeping, and to render them as expensive as possible, that I could not help feeling a strong desire to counteract this tendency in some measure, at least in as far as it affects the comforts and enjoyments of the poor.

The natural, and the fair object of the exertions of the industrious part of mankind, being the acquirement of wealth, *their* ingenuity is employed and exhausted in supplying the wants, and gratifying the taste of the rich and luxurious.

It is not *their* interest to encourage the practice of economy, except it be *privately*, in their own families.

Though I sometimes speak with indignation of some of those ridiculous forms, under which unmeaning and ostentatious dissipation too often insults common decency, and mortally offends every principle of good taste and elegant refinement, I am  
very,

very, very far, from wilhing to diminish the expences of the rich.

I well know that the free circulation of the blood is not more essentially necessary to the health of a strong athletic man, than the free and *rapid* circulation of money is necessary to the prosperity of a great manufacturing and commercial country, whose power at home and abroad is necessarily maintained at a great expence.

Those who would take the trouble to meditate profoundly on the influence which taxes and luxury necessarily have, and ever must have, in promoting that circulation, would, I am confident, become more reconciled to the present state of things, and less alarmed at the progressive increase of public and private expence.

It is apathy, and a general *corruption of taste* (which is inseparably connected with avarice and a *corruption of morals*)—and not the progress of elegant refinement, that is a symptom of national decline.

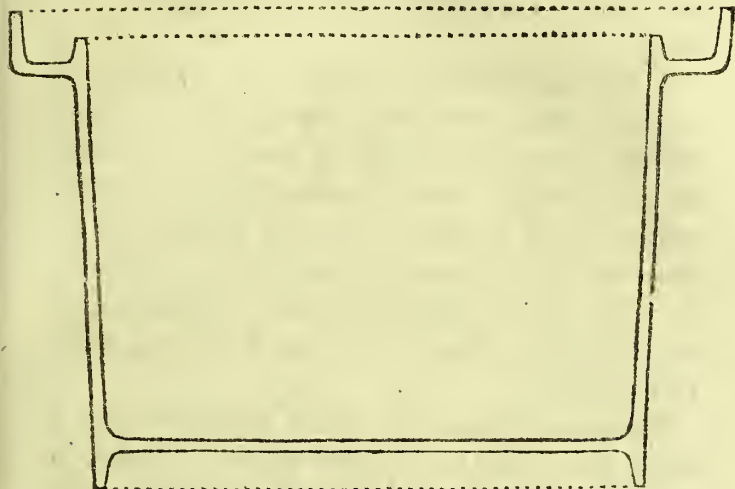
But to return to my subject.—The boiler above recommended (see figure 78) is peculiarly well adapted for being used with the small portable furnaces described in the *eleventh* chapter of this essay; and as these furnaces will not be expensive, I would strongly recommend them for the use of poor families, to be used with the utensils I have just been describing.

A cast-iron portable furnace, with one of these boilers, and one of the cheap tea-kettles described in the last chapter, which might all be purchased  
for

for a small sum, would be a most valuable acquisition to a poor family. It would not only save them a great deal in fuel, and in time employed in watching and keeping up the fire in cooking their victuals, but it would also have a powerful tendency to facilitate and expedite the introduction of essential improvements in their cookery—which is an object of much greater importance than is generally imagined.

The boiler in question (represented in the figure 78) is made double, or rather it is suspended in an hollow cylinder of sheet-iron. This hollow cylinder is certainly useful, as it serves to confine the heat about the boiler; but as it renders the implement more expensive, and may wear out, or be destroyed by rust, after a certain time, I shall now shew how a boiler, proper to be used with one of the portable furnaces before recommended, may be so constructed as to answer without an hollow cylinder.

The following figure represents a vertical section of such a boiler, of cast-iron, drawn to a scale of four inches to the inch :

*Fig. 82.*

The essential difference between this boiler and that last described, consists in a rim of about  $\frac{3}{4}$  of an inch in depth, which descends below its bottom, and forms a kind of foot, on which it stands. This foot being made of such diameter as to fit the sand-rim of the furnace, into which it enters when the boiler is placed over the furnace, the flame and smoke of the fire are confined under the bottom of the boiler, quite as effectually as if the boiler were suspended in a cylinder.

It can hardly be necessary that I should observe here—what would probably occur to the reader without my mentioning it—that stew-pans and sauce-pans for register-stoves, and for portable furnaces of all kinds, with steam-rims, might be constructed on this simple principle.

It



It is on this principle that the tea-kettles are constructed that were recommended in the last chapter.

I shall finish this chapter by a few observations respecting the means that may be used for combining the method of cooking here recommended for poor families, with the warming of their habitations in cold weather. This can most readily be done by using an inverted, tall, hollow, cylindrical vessel, of tin, thin sheet-iron, or sheet-copper, as a cover to the boiler (or to the steam-dish, when that is used).

This will change the whole apparatus into a steam-stove, which, as I have elsewhere shewn, is one of the best kinds of stoves that can be used for warming a room.

Whenever this is done, care must be taken to stop up the chimney fire-place with a chimney-board, otherwise all the air warmed by the stove, and rendered lighter than the external air, will find its way up the chimney, and escape out of the room. A small opening must, however, be left for the tube which carries off the smoke from the portable furnace into the chimney.

But whenever it is intended that a portable kitchen furnace should be used occasionally for warming a room by means of steam, it will be very advisable to construct the furnace with an opening on one side of it, for the purpose of introducing the fuel, without removing the boiler.

But even should no use whatever be made of this cooking apparatus in warming the room, the use  
of

of it will nevertheless be found to be very economical. The quantity of fuel consumed in preparing food will be greatly diminished ; and as a fire may at any time be lighted in one of these portable furnaces, almost in an instant, there will be no longer any necessity, nor any excuse, for constantly keeping up a fire on the hearth in warm weather, which is but too often done in this country, even in places where fuel is neither cheap nor plenty. And even in winter, when a fire in the grate is necessary to render the room warm and comfortable, it will still be good economy to light a small separate fire in a portable furnace, or other closed fire-place, for the purpose of cooking ; for nothing is so ill-judged as most of those attempts that are so frequently made by ignorant projectors *to force the same fire to perform different services at the same time.*

The *heat* generated in the combustion of fuel is a *given quantity*, and the more *directly* it is applied to the object on which it is employed, so much the better, for the less of it will escape, or be lost on the way ; and what is taken away on one side for a particular purpose, can produce no effect whatever on the other—where it is not.

## CHAP. XIV.

*Miscellaneous observations respecting Culinary Utensils of various kinds, &c.—Of cheap Boilers of Tin, and of Cast-iron, suitable to be used with Portable Furnaces.—Of earthen Boilers and Stew-pans proper for the same use.—Of LARGE PORTABLE KITCHEN FURNACES, with fire-place doors.—Description of a very cheap SQUARE BOILER of sheet-iron, suitable for a PUBLIC KITCHEN.—Of PORTABLE BOILERS and Fire-places that would be very useful for preparing food for the poor in times of scarcity. Of the ECONOMY of HOUSE-ROOM in the arrangement of a Kitchen for a large family.—A short account of the COTTAGE GRATE, and of a small GRIDIRON GRATE for open chimney fire-places.—A description of a DOUBLE DOOR for closed fire-places.*

**A**LTHOUGH my Essays are professedly *experimental*, and I seldom or never presume to trouble the Public with mere speculations, or to recommend any mechanical contrivance till I have been convinced of its utility *by actual experiment*, yet my inquiries have been so numerous, and so varied, that I am frequently apprehensive of embarrassing my reader, and perhaps tiring and disgusting him by too great a variety of detail. To avoid that evil (which would be fatal to all my hopes) I shall, in this chapter, pass as rapidly as possible over a great number of different objects, many of which

which will, no doubt, be considered as curious and important. And to relieve the attention of the reader, and also to make it easy for him to pass over what he may have no curiosity to examine, I shall divide my subject as much as possible, and shall treat each distinct branch of it under a separate head of inquiry.

I shall likewise make a liberal use of figures, for by means of them it is often possible to convey more satisfactory information at a single glance, than could be obtained by reading many sentences. Whenever I set down to write, I feel my mind deeply impressed with a sense of the respect which I owe, as an individual, to the Public, to whom I presume to address myself; and often consider how blameable it would be in me, especially when I am endeavouring to recommend economy, to trifle with the time of thousands.

Too much pains cannot be taken by those who write books, to render their ideas clear, and their language concise, and easy to be understood.

*Hours* spent by an author in saving *minutes*, or even *seconds*, to his readers, is time well employed.—But I must hasten to get forward.

*Of the construction of cheap Boilers and Stew-pans, of tin or cast-iron, proper to be used with small Portable Furnaces.*

These utensils, when they are made of tin, may be constructed on the same principles as the tea-kettles described in the last chapter; that is to say,

their bottoms being raised up about half an inch above the level of the lower part of their conical or cylindrical sides; and being moreover made of a proper diameter to fit the sand-rim of the furnace, they may be used without being made double—when they are of cast-iron, they may be made of the same form below as the boiler represented by the figure 82, and particularly described in the last chapter.

*Of earthen Boilers and Stew-pans proper to be used with Portable Furnaces.*

Although the earthen stew-pan represented by the figure 74 (see chapter XII.) is of a good form, yet those represented by the two following figures have likewise their peculiar merit. They are of forms which render them well adapted for being suspended in hollow cylinders of sheet-iron, and for their being defended by those cylinders from being broken by accidental falls and blows. From a bare view of them the reader will be able to appreciate their relative merit; and also to discover the particular objects had in view in the contrivance of them. The second (figure 84.) has a steam-rim, and consequently may be used for cooking with steam by means of a steam-dish.



Fig 83

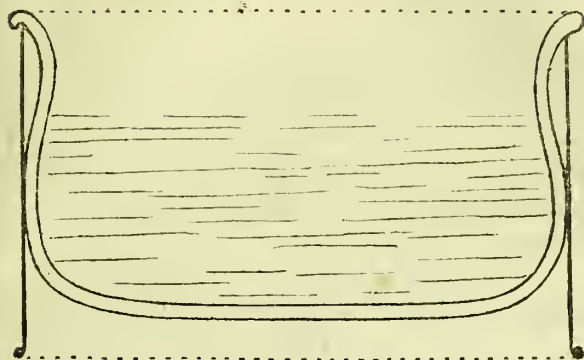
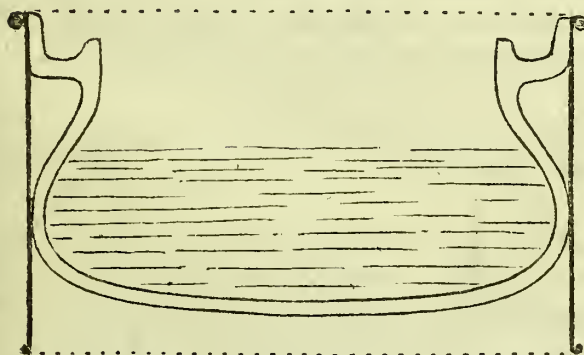


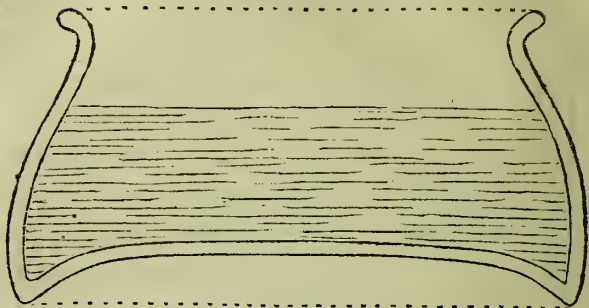
Fig 84



It would, no doubt, be very possible to construct earthen boilers and stew-pans of such forms as to render them capable of being used with portable furnaces without being suspended in hollow cylinders. An earthen stew-pan or sauce-pan, of the form represented by the following figure, would probably answer for that purpose :

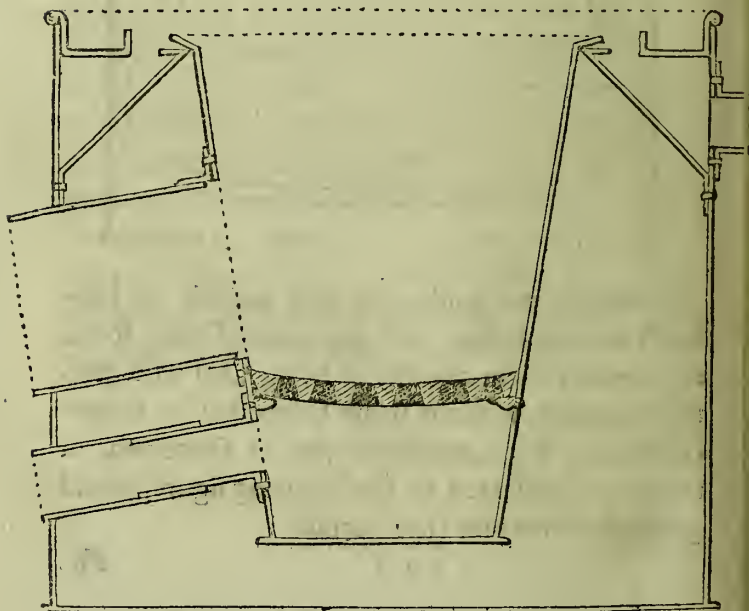
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Fig.

*Fig. 85*

*Of large Portable Kitchen Furnaces, with Fire-place  
Doors.*

The following figure represents a vertical section (drawn to a scale of 6 inches to the inch) of a portable furnace of this kind, constructed of sheet-iron :

*Fig. 86.*

Furnaces

Furnaces of this kind might, I am confident, be made very useful in many cases. Wood, coals, charcoal, or turf, might, indifferently, be used with them; and no contrivance is better calculated for promoting both the economy of fuel, and that of house-room.

Portable furnaces, on this principle, might easily be made of cast-iron, which would be both cheap and durable; or, they might be constructed partly of cast-iron, and partly of sheet-iron, in the manner recommended in the eleventh chapter, in respect to portable furnaces without fire-place doors.

The door belonging to this fire-place is not represented in the foregoing figure. It may be an hollow cylindrical stopper made of sheet-iron.

*Description of a very cheap square Boiler, of sheet-iron, suitable for a public Kitchen.*

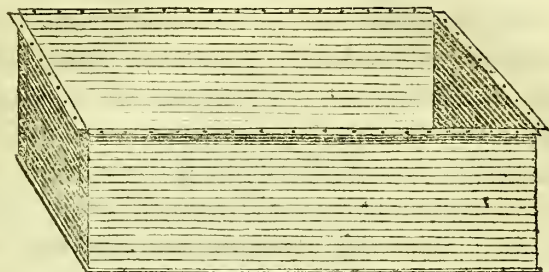
As some of the most wholesome and nourishing, as well as most palatable kinds of food that can be prepared, are rich and savoury soups and broths; and as many of these can be afforded at a very low price, especially when they are made in large quantities, there is no doubt but the use of them will become more general, and that they will in time constitute an essential, if not the principal part of the victuals furnished to the poor, in every country, from public kitchens; and also to those who are lodged in hospitals, or confined in prisons. And,

as the rich flavour, and nutritious quality—or in other words, the *goodness* of any soup, depends very much on *the manner of cooking it*;—that is to say, on its being boiled, or rather *simmered* for a long time, over a very slow fire, the form of the boiler, and the form of the fire-place, are both objects of great importance.

The simplicity and cheapness of the machinery, and the facility of procuring it in all places, and getting it fitted up, are also objects to which much attention ought to be paid. Refined improvements, which require great accuracy in the execution, and much care in the management of them, must not be attempted.

The boiler I would propose for the use of public kitchens, is similar in all respects to that which has been adopted at Hamburgh, after a model sent from Munich; for although there is nothing about this boiler that indicates the display of much ingenuity in its contrivance, yet it has been found to answer very well as often as it has been tried; and its great simplicity renders it peculiarly well adapted for the use for which it is recommended.

A perfect idea of this boiler may be formed from the following figure, where it is represented without the wooden curb to which it is fixed when it is set in brick-work:

*Fig: 37.*

This boiler is 24 inches wide, 36 inches long, and 15 inches deep, consequently, when it is filled to within 3 inches of its brim, or when the liquor in it stands at the depth of 12 inches, it contains 10364 cubic inches, which make above  $36\frac{1}{2}$  beer gallons.

It should be constructed of sheet-iron tinned on the inside; and when it is not in use, care should be taken to wipe it out very dry, with a dry cloth, to prevent its being injured by rust; and as often as it is put away for any considerable time, it should be smeared over with fresh butter, or any other kind of animal fat, unmixed with salt.

The sheet-iron will be sufficiently thick and strong if the boiler when finished weigh 40 pounds; and as the best sheet-iron costs no more than about  $3\frac{1}{2}d.$  per lb. the manufacturer ought not to charge more than  $6d.$  per lb. for the boiler when finished, which, if it weigh 40 lb. will amount to 20s.

To strengthen the boiler at the brim, it must be fastened to a curb of wood, which may be a frame  
of



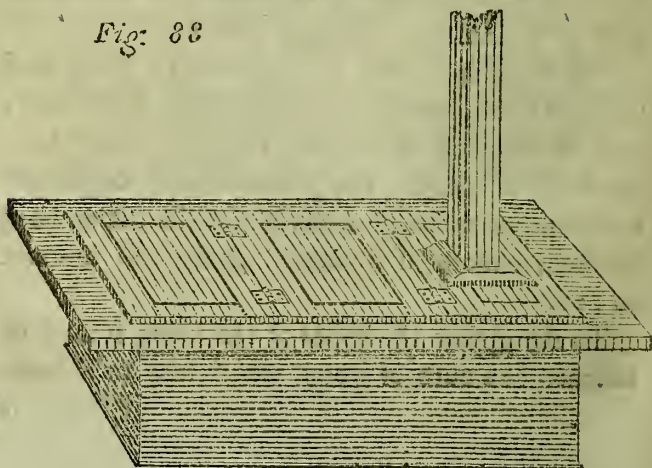
of board  $1\frac{1}{4}$  or  $1\frac{1}{8}$  inch thick, 5 inches wide, and just large enough to allow the boiler to pass into it, and be suspended by its projecting brim. This brim, which may be made about an inch wide, must be fastened down upon the wooden curb with tinned nails, or with small wood screws.

This curb will be 3 feet 10 inches long, and 2 feet 10 inches wide; and as the stuff used is 5 inches wide, it will measure very nearly  $2\frac{1}{4}$  feet, superficial measure, which, at 6 *d.* the foot (which would be a fair price in London for the work when done) would amount to 1 *s.* 4  $\frac{1}{2}$  *d.*

The boiler must be furnished with a cover, which may be made of wood, and should consist of three distinct pieces, framed and pannelled, and united by two pair of hinges, as they are represented in the following figure.

This cover will measure about 7 superficial feet, and, at 7 *d.* the foot, will cost 4 *s.* 1 *d.* The hinges may cost about 4 *d.* the pair, consequently the cover will cost, all together, about 4 *s.* 9 *d.*

*Fig: 88*



This

This figure represents the boiler fixed in its wooden curb, and with its cover in its place.

The first division of the cover (which is 12 inches wide) is laid back on the second (which is 14 inches wide) whenever it is necessary to open the boiler to put any thing into it, or to take any thing out of it, or merely to stir about its contents. When the boiler is to be washed out and cleaned, the opening into it is made larger, by throwing back the first and second divisions of its cover, folded one upon the other, and leaning them against the steam tube, which stands upon the third division of the cover, which division is firmly fixed down upon the curb of the boiler by means of wood screws.

The steam tube (which should be of sufficient length to carry the steam from the boiler out of the room into the open air, or into a neighbouring chimney) may be made of four slips of  $\frac{3}{4}$  inch thick deal boards, fastened together (by being grooved into each other, and nailed together) in such a manner as to form an hollow square trunk, measuring about  $1\frac{1}{4}$  inches wide in the clear.

In setting this boiler in brick-work, the flame and smoke from the fire should be made to act on its bottom only, but its sides and ends should be bricked up, in order more effectually to confine the heat. The mass of brick-work should be just 3 feet 8 inches long, and 2 feet 8 inches wide, in order that the curb of the boiler may cover it above, and project beyond it, horizontally, on every side, about half an inch. The bars of the fire-place on  
which

which the fuel burns, should be situated 12 or 14 inches below the bottom of the boiler, in order that the boiler may not be injured when the fire happens, by accident, or by mismanagement, to be made too intense.

It is not necessary that I should mention here any of the precautions which are to be observed in setting boilers of this kind in brick-work ; for that subject has already been so amply treated in various parts of these Essays, that, to add any thing to what has already been said upon it, could be little better than an unnecessary and tiresome repetition.

This boiler would be sufficiently large for cooking for about 300 persons. If it were necessary to feed a much greater number from the same kitchen, I would rather recommend the fitting up of two or more boilers of this size, than constructing one large boiler to supply the place of a greater number of others of a moderate size ; for I have found by much experience, that very large boilers are far from being either economical or convenient.

Large boilers of sheet-iron, and especially such as are not kept in constant use, are always *very expensive*, on account of their being so liable to be destroyed by rust.

*Of Portable Boilers and Fire-places, that would be very useful for preparing Food for the Poor in times of Scarcity.*

There is always much trouble and inconvenience,  
and

and frequently much danger in collecting together great numbers of idle people; and these assemblies are never so likely to produce mischievous effects as in times of public calamity, when it is peculiarly difficult to preserve order and subordination among the lower and most needy classes of society.

I have often trembled at seeing the immense crowds of poor people, without occupation, who were sometimes collected together at the doors of the great public kitchens in London during the scarcity of the year 1800.

Two or three hundred people may, without any considerable inconvenience, be supplied with food from the same kitchen; but when public kitchens are not connected with asylums, or houses or schools of industry, where the poor assemble to work during the day; and when there is no other object in view, but merely to enable the poor to purchase good and wholesome food at the lowest prices possible, without any interference at all with their domestic employments or concerns, it appears to me that it would always be best to select from amongst the poor a certain number of honest and intelligent persons, and encourage them to prepare and sell to their poor neighbours, under proper regulation and inspection—such kinds of food, and at such prices, as should be prescribed by those who have the charge of providing for the relief of the poor.

A plan of this sort might be executed at any time on the pressure of the moment, without the smallest



smallest delay, and almost without either trouble or expence, if each parish, or community, were to provide and keep ready in store, a certain number of portable kitchen furnaces, with boilers belonging to them, to be lent out occasionally to those who should be willing to undertake to cook and sell victuals to the poor on the terms that should be proposed.

If these boilers were made to hold from 8 to 10 gallons, they would serve for preparing food for 60 or 70 persons; and as they would require very little fuel, and so little attendance, that a woman who should undertake the management of one of them, might perform that service with great ease, by devoting to it each day the labour of half an hour, and giving to it occasionally a few moments of attention, which would hardly interrupt her in her common domestic employments; this method of preparing food would be very economical—perhaps more so than any other;—and, with proper inspection, it would be little liable to abuse.

How very useful would these portable boilers and furnaces be for providing a warm and cheap dinner for children who frequent schools of industry?

No furnace could, in my opinion, be better contrived for this use than that represented in the figure 86, and the boiler might be made either of sheet-iron tinned, or of copper tinned, or of cast-iron. It cannot be necessary that I should give any particular directions respecting its form;—and its dimensions may easily be computed from its capacity, when that is determined on.

A portable



A portable cooking apparatus of this kind, which is designed as a model for imitation, may be seen in the repository of the Royal Institution.

*Of the economy of House-room in the arrangement of a Kitchen for a large Family.*

There is nothing which marks the progress of civil society more strongly than the use that is made of house-room; and nothing would tend more to prevent the too rapid progress of destructive luxury among the industrious classes, than a taste for neatness and true elegance in all the inferior details of domestic arrangement. The pleasing occupation which those objects of rational pursuit afford to the mind, fills up leisure time in a manner that is both useful and satisfactory, and prevents *ennui*, and all its fatal consequences.

The Poor cook their victuals in the rooms in which they dwell; but those who can afford the expence—and many indeed who cannot—set apart a room for the purpose of cooking, and call it a kitchen. I am far from desiring to alter this order of things, for I think it perfectly proper. What I wish is, that each class of society may be made as comfortable as possible, and that all their domestic arrangements may be *neat* and *elegant*, and at the same time *economical*.

I always fancy that teaching industrious people economy, and giving them a taste for the improvement of all those useful contrivances, and rational enjoyments, that are within their reach, is something

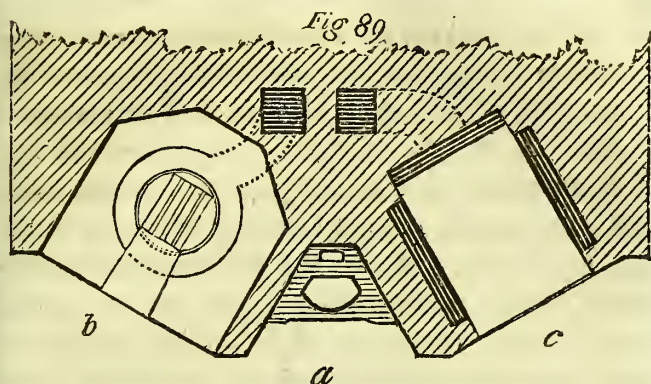
thing like shewing them how—without either toil or trouble—and with a good conscience—they may obtain all those advantages which riches command, together with many other very sweet enjoyments which money cannot buy. And whose heart is so cold as not to glow with ardent zeal at a prospect so well calculated to awaken all the most generous feelings of humanity?

But to return from this digression:—There are various methods that may be used for economizing house-room, in making the necessary arrangements for cooking. If the family be small, the use of portable furnaces and boilers will be found to be very advantageous.

For a large family I would recommend what I shall call a *concealed kitchen*: There are two very complete kitchens of this kind, which have been fitted up, under my direction, at the Royal Institution;—the one, which is small,—is in the house-keeper's room; the other is in the great kitchen. These were both made as models for imitation, and may be examined by any person who wishes to see them.

There are also two kitchens of this kind in my house at Brompton, in two adjoining rooms; which have been fitted up principally with a view to shewing that all the different processes of cookery *may* be carried on in a room, which, on entering it, nobody would suspect to be a kitchen. The following figure is the ground plan of one of them:

*Fig.*



*a* is the opening of the fire-place, which is brought forward into the room about  $14\frac{1}{2}$  inches. This was done in order to give more room for the family boiler, which is situated at *b*, and the roaster, which is placed on the other side of the open chimney fire-place at *c*.

The two broad spaces on the two sides of the roaster, by which the smoke from the fire below it rises up round it ; and another at the farther end of it, by which the smoke descends, are distinguished by dark shades, as are also the two square canals by which the smoke from the roaster, and that from the boiler, rises up into the chimney.

The top of the grate is seen which belongs to the open chimney fire-place ; it is represented by horizontal lines. It is what I have called a *cottage grate*, and what is sold in the shops under that name. The retail price of this grate, with its fender and trivet, is *ten shillings and six pence*. The Carron Company entered into an engagement with

me to furnish them by wholesale to the trade, delivered in London, at *seven shillings and six pence*. A front view of this grate may be seen in the next figure. As this figure (89) is designed merely for shewing *where* the different parts of the apparatus are to be placed, and not *how* they are to be fitted up, none of the details of the setting of the roaster or boiler were in this place attempted to be expressed with accuracy. Information respecting those particulars must be collected from other parts of the work.

The grate represented in this figure is calculated for boiling a pot, or a tea-kettle, and for heating flat-irons for ironing. Its bottom is so contrived as to be easily taken away, and replaced. By removing it at night, or whenever a fire is no longer wanted, the coals in the grate fall down on the hearth, and the fire immediately goes out. This contrivance not only saves much fuel, which otherwise would be consumed to waste, but it is also very convenient on another account : As all the coals and ashes fall out of the grate when its bottom is removed, on replacing it again the grate is empty, and ready for a new fire to be kindled in it.

The top of this grate, which is a flat plate of cast-iron, has one large hole in it for allowing the smoke to pass upwards, and another, behind it, which is much smaller, through which it is forced to *descend* into what has been called a *diving flue*, whenever the boiler belonging to this fire-place is used ; which boiler is suspended in an hollow cy-



under of sheet-iron, about  $11\frac{1}{2}$  inches in diameter, resembling in all respects the boilers used with the register-stoves described in the tenth chapter of this essay.

I intend, as soon as it shall be in my power, to publish a particular detailed account of this grate, and also of several others, for open chimney fire-places, which, at my recommendation, have lately been introduced in this country; in the mean time I avail myself of this opportunity of pointing out one fault which has been committed by almost all those who have undertaken to set *cottage-grates* in brick-work: they have made what has been called the *diving flue* much too deep. It is more than probable that the name given to this flue has contributed not a little to lead them into this error. When properly constructed it hardly deserves the name of a *flue*, for it ought not to be above *two inches deep*, measured from the under surface of the flat plate of cast-iron, which forms the top of the grate. There are two important advantages that result from making this opening in the brick-work for the passage of the smoke *very shallow*;—the one is, that in this case it may easily be cleaned out, when coals happen to fall into it, by accident, when it is left uncovered;—and the other is, that the back wall of the fire-place, against which the fuel burns, may, in that case, be made thick and strong, and not so liable to be destroyed by the end of the poker in stirring the fire, as it is when there is an hollow flue just behind it.



Both these are important objects, and for want of due attention being paid to them, cottage grates have, to my knowledge, often been disgraced and rejected. When they are properly set and properly managed, they are very useful fire-places where coal or turf is burnt; and it never was designed that they should be used with wood.

When kitchens are fitted up on the plan here recommended, in places where wood is used as fuel, the open chimney fire-place, which is situated between the roaster and the boiler, may be constructed *of the form* represented in the foregoing figure, but without any fixed grate; and the wood may be burnt on andirons, or on a small moveable *gridiron-grate* placed on the hearth.

These *gridiron-grates* are very simple in their construction, cheap, and durable; and they make an excellent fire, either with coals or turf, or with wood, if it be sawed or cut into short billets. Five of these grates may be seen at the house of the Royal Institution; one in the great lecture-room, one in the apparatus-room, one in the manager's-room, one in the clerks room, and one in the dining-room. They have hitherto been made of two sizes only, namely, of 16 inches and of 18 inches in width, in front. The width of the back part of the grate is always made just equal to half its width in front, and the two sloping sides, or ends of the grate, are each just equal in width to the back. The form and dimensions of the grate determines the form and dimensions of the open chimney

chimney fire-place in which it is used, for the back of the fire-place must always be made just equal in width to the back of the grate, and the sloping of the covings must be the same as the sloping of the ends of the grate.

From what has been said of the proportions of the front, back, and sides of these grates, it is evident that the covings and backs of their fire-places must make an angle with each other just equal to 120 degrees. This angle I have been induced to prefer to one of 135 degrees, which I formerly recommended for open chimney fire-places: the reasons for this preference will be fully explained in another place. To give them here would take up too much time, and would moreover be foreign to my present subject.

For the information of the public, and to prevent, in as far as it is in my power, exorbitant demands being made for these useful articles, I would just observe, that the smallest, or 16 inch *gridiron-grate*, together with all the apparatus belonging to it, ought to cost, *by retail*, no more than *seven shillings*. This apparatus consists of a cast-iron fender; a trivet for supporting a boiler or a tea-kettle over the fire; and a small plate of cast-iron (to be fastened into the back of the chimney) by means of which, and a small bolt or nail, the grate is fastened in its place on the hearth.

The second sized, or 18 inch *gridiron-grate*, with all its apparatus (consisting of the three articles mentioned above) ought to be sold, by retail, for *seven shillings and six pence*.

### 358      *Of Kitchen Fire-places, and Utensils.*

The *wholesale price* of these articles, at the Carron Company's warehouse in London (Thames-street, near Blackfriar's-bridge) to the trade ; and to gentlemen who buy them by the dozen to distribute them to the poor, is

For the gridiron-grate, N<sup>o</sup> 1. with } *four shillings.*  
the articles belonging to it

For that N<sup>o</sup> 2, with the articles } *four shillings*  
belonging to it    -    -    -    } *and six pence.*

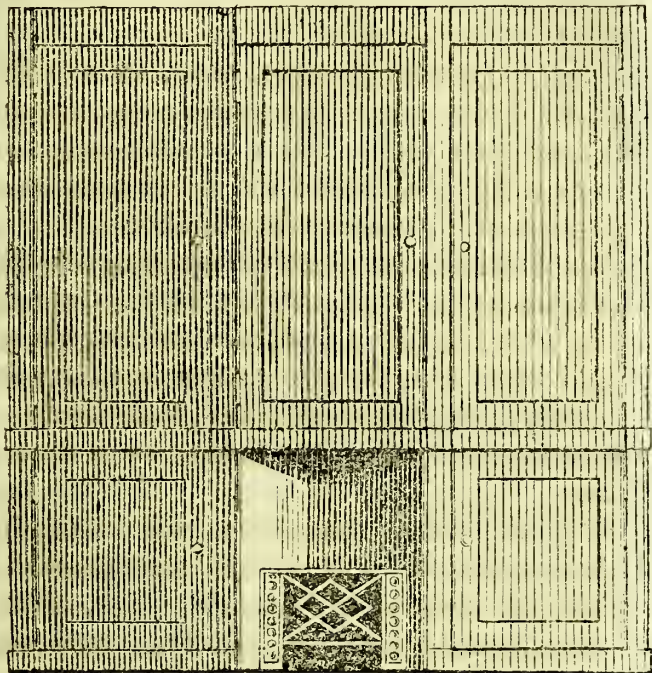
These are the wholesale and retail prices which I fixed with the agent of the Carron Company, at their works in Scotland, in the autumn of the year 1800, when I made a journey there for the purpose of establishing these regulations; and when I made a present to the Company of all my patterns which I had got made in London, and which had been rendered as perfect as possible by previous experiments—namely, by getting castings taken from them by the best London founders, and altering them occasionally, till they were acknowledged to be quite complete.

If it had been possible for me to have done more to prevent impositions, I should have done it with pleasure; and I should have felt at the same time that I had done no more than what it was my duty to do.

But to return from this long digression ;—I shall now hasten to finish my account of the means which have been used in one of the rooms in my house (that destined for the large kitchen) for concealing the roaster and the family boiler.

The

The following figure is an elevation of that part of the side of the room where these implements are concealed:

*Fig: 70*

The open chimney fire-place, and the front of the grate, are distinctly shewn in the middle of this figure, in the lower part of it. The pannelled door, immediately above the mantle of the chimney fire-place, which reaches nearly to the ceiling of the room, serves to shut up a small closet, with narrow shelves, which has no connection with culinary affairs, but is used for putting away candle-



sticks, and any other small articles used in house-keeping, which are occasionally laid by when not in actual use. The two other pannelled doors by the side of it serve, the one (that on the right hand) for concealing the roaster—and the other for concealing the family boiler.

The two (shorter) pannelled doors, on the right and left of the open chimney fire-place, and on the same level with it, serve for concealing the fire-place doors, and ash-pit doors of the closed fire-places of the roaster, and of the boiler.

The steam from the boiler (after passing through the steam-dishes, when they are used) is carried off by a tin tube into a small canal, which conveys it into the chimney in such a manner that no part of it comes into the room. The steam from the roaster is carried off in like manner by its steam-tube.

If a void space, about 2 or 3 inches in depth, be left between the outside of the door of the roaster, and the inside of the pannelled door, which shuts it up and conceals it, and if this pannelled door, be lined on the inside with thin sheet-iron, the process of roasting may be carried on, with perfect safety, with this door shut. And if similar precautions be used to defend the other pannelled doors from the heat, they may also be kept shut, while the processes of boiling and roasting are actually going on.

By these means it would be *possible* to prepare a dinner for a large company in a room where there  
should



should be no appearance of any cooking going on. But I lay no stress on this particular advantage resulting from this arrangement of the culinary apparatus. The real advantage gained by it is this, that the kitchen is left an *habitable*, and even an *elegant room*, when the business of cooking is over.

The kitchen in Heriot's Hospital at Edinburgh, which was fitted up in the autumn of the year 1800, is arranged in this manner; with this difference however, that all the pannelled doors are omitted. The boiler is shut up by a door of sheet-iron, japanned; and the door of the roaster, and the two fire-place doors, and two ash-pit register doors, are exposed to view.

As the brick-work is white washed, and kept clean, and as the doors are all either japanned black or kept very clean, the whole has a neat appearance.

The roaster and principal boiler in the great kitchen of the house of the Royal Institution, are put up nearly in the same manner as those in Heriot's Hospital, excepting, that in the former there is a hot-closet, which is situated immediately above the roaster, whereas there is none belonging to the latter.

In one of the kitchens in my house, there is—in the place of the roaster—a roasting oven, with a common iron oven of the same dimensions placed directly over it, and heated by the same fire.

The door of my roaster, and that of my roasting oven, are made single, of thin sheet-iron, and they  
are

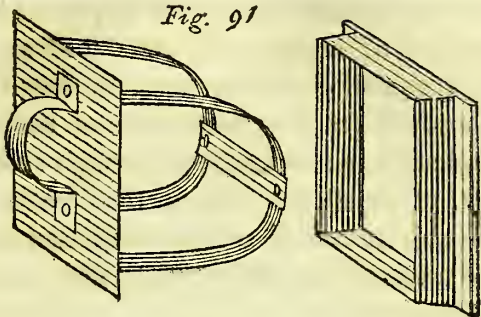
are covered on the outside with pannels of wood, for confining the heat. Instead of doors to their closed fire-places, I use square stoppers, made of fire-stone, or hard fire-brick, fastened to flat pieces of sheet-iron; to which knobs of wood are fixed, which serve instead of handles.

These stoppers answer for confining the heat quite as well, and perhaps even better, than double doors, and they cost much less. They are fitted into square frames of cast-iron, (nearly similar to that represented in the figure 91) which are firmly fixed in the brick work by means of projecting flanches, which are cast with them. The front edge of this frame, or door-way, is ground, and made perfectly level, and the plate of sheet-iron which forms a part of the stopper being made quite flat, shuts against the front edge of this door-way, and closes the entrance into the fire-place with the greatest accuracy.

The entrance into the ash-pit is likewise closed by a stopper, which is so contrived as to serve occasionally as a register for regulating the quantity of air admitted into the fire-place.

As this *Register-stopper*, for the ash-pit of a small closed fire-place, is very simple in its construction, and as I have found it to answer very well the purpose for which it was contrived, I shall present the reader with the following sketch of it; which will, I trust, be sufficient to enable a workman of common ingenuity to construct, without difficulty, the thing which is represented.

*Fig.*

*Fig. 91*

The box, with a flanch at each of its ends, forms the door-way into the ash-pit ; it is of cast-iron, and its opening in front is  $7\frac{1}{4}$  inches wide, and  $3\frac{1}{4}$  inches high. It is concealed in the brick-work in such a manner that its front edge only is seen, projecting about  $\frac{1}{8}$  of an inch before the brick-work.

When the register-stopper belonging to this door-way, (which is shewn in this figure) is pushed quite home, its flat plate comes into contact with the front edge of the door-way, and closes the passage into the ash-pit so completely that no air can enter. By withdrawing this stopper more or less, more or less air is admitted.—The narrow, thin, elastic bands of iron, the ends of which are fastened by rivets to the flat plate of the stopper, serve to confine the stopper in any situation in which it is placed, which service they are enabled to perform (in consequence of their elasticity, and of their peculiar shape) by pressing against the sides of the door-way.

The

The only objection, that I am acquainted with, to this kind of register for the door-way of the ash-pit of a small closed fire-place, is, that it is not quite so easy to see the precise state of the register as it is when the air is admitted through an hole in the front of the ash-pit door, in the usual manner; but this objection is of no great importance, especially as means may easily be devised to remedy that trifling defect.

The door-way frames to all the closed fire-places in my own kitchen, are in all respects like that represented in the foregoing figure (91) with this difference only, that they are 5 inches high instead of being  $3\frac{1}{2}$  inches in height. An account has already been given of the manner in which their stoppers were constructed.

It is right that the reader should be informed, that although I have made use of stoppers to close the passage into each of the closed fire-places in my own kitchen, yet very few persons have adopted this simple and cheap contrivance. The reason why it has not come into more general use might easily be explained; but I fancy it will be best that I should say nothing now on that subject. Instead of recommending what nobody would find much advantage in furnishing at a fair price, it will be more wise and prudent to give a short description of a more complicated, more elegant, and more expensive contrivance, which has already found its way into the shops of several of the most respectable ironmongers in London: As this contrivance has  
often

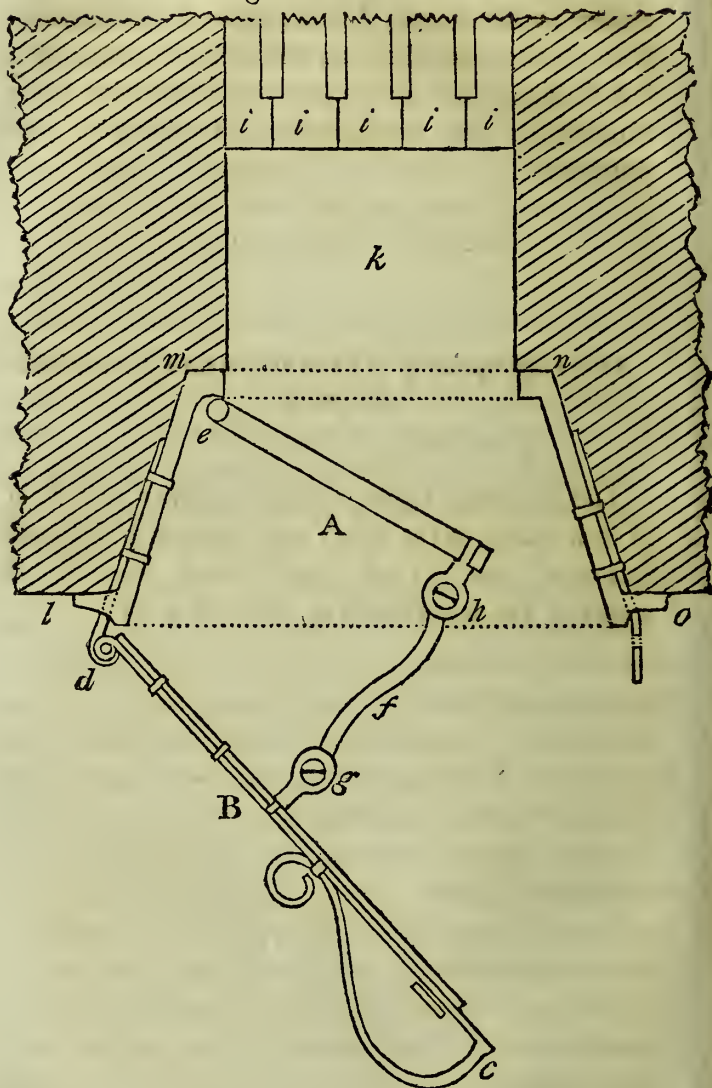
often been used, and has always been found to answer perfectly well, I can venture to recommend it to all those to whom an additional expence of a few shillings, or a guinea or two, in fitting up a kitchen, is not considered as an object of importance.

*A short description of a DOUBLE-DOOR for a closed fire-place.*

The following figure (which is drawn to a scale of four inches to the inch) represents an horizontal section of one of these double-doors, and also of a part of the brick-work in which it is set :



Fig 92



A, is the inside door, and B is the outside door  
—These

—These doors are so connected, by means of a crooked rod of iron *f*, and the two joints *g* and *h*, that when the outside door is opened, or shut, the inside door is necessarily opened, or shut, at the same time. The inside door, which is of cast-iron, and near  $\frac{1}{2}$  an inch in thickness, is moveable on two pivots, one of which is represented at *e*. The outside door is moveable on two hinges, one of which is shewn at *d*.

*c*, is the latch by which the outside door is fastened. This is of such a form that it may be used as a latch, and may serve at the same time as an handle for opening and shutting the door.

The door-way, which is of cast-iron, is in the shape of an hollow truncated quadrangular pyramid, with a flanch in front, about an inch wide; which flanch, when seen in front, seems to form a kind of frame to the outside door, the flanch, which is about  $\frac{1}{4}$  of an inch in thickness, projecting before the vertical front of the brick-work.

*l, m, n, o*, represents an horizontal section of this cast-iron door-way. The brick-work in which it is set is distinguished by diagonal lines.

*k*, is the passage leading to the fire-place; it is 6 inches wide, in the clear, from *m* to *n*;—5 inches high, and 6 inches long; measured from the inside of the inside door, when it is shut, to the hither ends of the openings between the iron bars of the fire-place; through which openings the air comes up from the ash-pit into the fire-place. The hither ends of these bars, (five in number) are represented in the figure: They are each distinguished by the letter *i*.

The,

The opening of the inside door-way is 6 inches wide, and 5 inches high in the clear ; and the door itself is  $6\frac{1}{2}$  inches wide, and  $5\frac{1}{2}$  inches high.

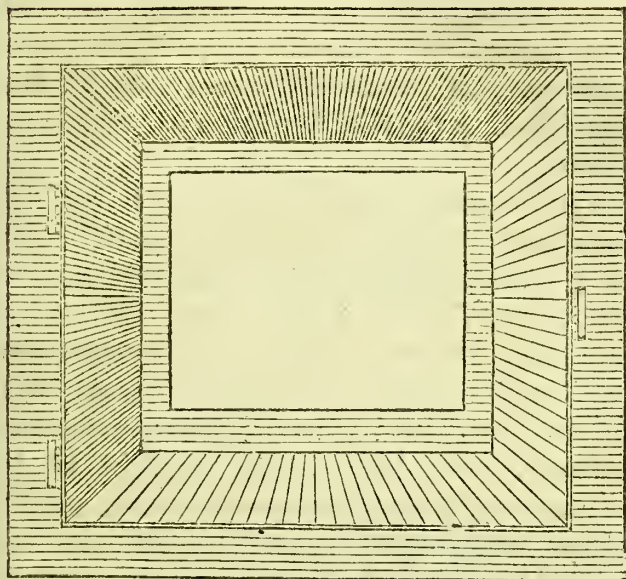
The outside door-way is 10 inches wide, and 9 inches high, in the clear ; and the door, which is about  $\frac{2}{10}$  of an inch in thickness, is  $10\frac{1}{2}$  inches wide, and  $9\frac{1}{2}$  high. The extreme width of the door-frame to the outward edge of the flanch is  $12\frac{1}{2}$  inches, and its extreme height is  $11\frac{1}{2}$  inches.

The two straps of iron to which the hooks of the hinges of the outside door are fastened, pass through two holes in the flanch, provided for them in casting the door-way, and are rivetted to the sloping side of the door-way on the left hand side of it.

These holes are each  $\frac{7}{8}$  of an inch in length from top to bottom, and about  $\frac{1}{4}$  of an inch in width. There is another similar hole in the flanch on the opposite side of the door-way, through which a strap of iron passes, the end of which projecting forward before the level of the front edge of the door-way, serves as a catch or hook, into which the latch of the door falls, when the door is closed.

These three holes in the side flanches of the door-way are distinctly represented in the following figure, which is an elevation, or front view of this door-way, without its doors :

*Fig. 93*



It appears by this figure, but still more distinctly by the last (92.) that the flanch or front of this door-way is not quite flat. It is raised at its inward edge, which projects forward about  $\frac{1}{4}$  of an inch. This projecting rim, which is cast as thin as possible, is ground upon a flat sand-stone, and made quite level, in order that the outside door, which is flat, by shutting against the front of this projecting edge, may close the opening into the fire-place with the greatest possible accuracy.

It will likewise be remarked on examining this figure (93.) with attention, that the opening which is closed by the inside door is not precisely in the middle of the vertical flat surface against which

that door shuts, being situated a little above the middle of it. This particular arrangement has been found to be of considerable use, as it serves to prevent small pieces of coal from getting between the inside door and that flat surface, when the door is shut.

These double doors (of a size larger than that represented by the two preceding figures) have lately been introduced in a considerable number of hot-houses in the neighbourhood of London; and I have been told by several persons who have tried them, that they have been found very useful indeed. I was lately assured by a very respectable gardener, who has adopted them in all his hot-houses, that since he has used them, and the register ash-pit doors which belong to them, and are always sold with them, and since he has altered the construction of his fire-places, his consumption of coals has been little more than half as much as it used formerly to be.

In setting these double doors in brick-work, great care should always be taken to make the entrance into the fire-place of some considerable length, or to keep the hither ends of the iron bars on which the fuel burns, at some distance from the inside door; otherwise, if the burning fuel be near that door, it will heat it and its frame red hot, which will soon destroy their form, and prevent the door from closing the entrance of the fire-place with accuracy.

I have found it to be a good general rule to  
place



place the hither ends of the bars, which form the grate of the fire-place, as far beyond the inside door, as that door-way is wide, in the clear. And it will be found to be an excellent precaution to defend the door from the heat, if that part of the passage into the fire-place which lies beyond the inside door, be kept constantly rammed quite full of small coals; or, what would be still better, of coal-dust, mixed up with a certain proportion of moist clay.

I have already, in a former part of this Essay, mentioned how necessary it is in setting double doors in brick-work, to take care to *mask* the farther end of the door-way, in such a manner (by means of bricks interposed before it, or between it and the fire) that the rays from the burning fuel may never fall on it. The manner in which this is to be done is clearly represented in the figure 92.

All these precautions for preventing these double doors from being injured by excessive heat, will be the more necessary in proportion as the fire-places are larger to which they belong.

There is one essential part of this apparatus, which, for want of room, was omitted in the two last figures;—that is, the straps of wrought iron, by means of which the door-way is firmly fixed in the brick-work; but this omission can be of no consequence, as every common artificer will know, without any particular directions, how that part of the work should be executed. These straps must of course be fastened to the cast-iron door-way by means of rivets.

## CHAP. XV.

*Apology for the great length of this Essay.—Regret of the Author that he has not been able to publish plans and descriptions of the various culinary inventions that have lately been put up in the Kitchen belonging to the House of the Royal Institution, and in the Kitchen of Heriot's Hospital at Edinburgh.—A short account of a BOILER, on a new construction, lately put up at the House of the Royal Institution, for the purpose of GENERATING STEAM for warming the Great Lecture Room.—This Boiler would probably be found very useful for STEAM ENGINES.—An account of a Contrivance for preventing metallic STEAM-TUBES from being injured by the alternate expansion and contraction of the metal by heat and cold.—An account of a simple Contrivance which serves as a substitute for SAFETY-VALVES.*

**I** CANNOT finish this Essay without apologizing for the great length of it. I had no idea when I began it that it would ever have grown to such a voluminous size, but I am not conscious of having inserted any thing that could well have been omitted.

I was very desirous of laying before the Public compleat plans and descriptions of the various culinary inventions that have lately been put up in the Great Kitchen of the house of the Royal Institution, in Albemarle-street; and also of those  
 \*  
 erected

erected in Heriot's Hospital at Edinburgh, in the autumn of the year 1800; but my stay in this country will be too short for me to undertake so considerable a work at this time. I am happy, however, that these new contrivances, some of which have already been proved to be very useful, are situated in places of public resort, where persons desirous of examining them may at all times obtain free admission.

There are also several other new and useful contrivances at the house of the Royal Institution, which I should have had great pleasure in laying before the public, had it been in my power; as I am persuaded that correct accounts of them would have been very acceptable to men of science, and to all those who take pleasure in promoting new and useful mechanical improvements.

I should, in particular, have been very glad to have given plans and descriptions of all the various parts of the steam-apparatus that has been put up for the purpose of warming the Great Lecture Room. The boilers for generating the steam are, if I am not much mistaken, well worthy of the attention of those who make use of steam-engines; and as the subject is of infinite importance in this great manufacturing country, where the numerous advantages which result from the use of machinery are known, and every day more and more felt by individuals, and by the public, I cannot resist the strong inclination which I feel, to attempt, in a

few words, to give a general idea of this contrivance. Those who wish to know more of the matter, may get all the information respecting it which they can want, by applying at the house of the Royal Institution.

*A short account of the BOILERS lately put up at the House of the Royal Institution for GENERATING STEAM for warming the Great Lecture Room.*

Over an oblong closed fire-place, furnished with double doors, ash-pit register door, &c. are placed two cylinders of copper, laid down horizontally, by the side of each other, over the fire, each cylinder being 15 inches in diameter and 48 inches long.—Immediately over these two cylinders, and resting on them, are placed two other cylinders of copper, of the same length and diameter; and over these last, and resting on *them*, are placed two other like cylinders, making six cylinders in the whole, all made of the same material, and being of the same dimensions.

The fire-place being situated under the hitler ends of the two lower cylinders, the flame runs along under them to their farther ends, where it passes upwards, and comes forward between the upper side of the two lower cylinders, and the lower sides of the two cylinders immediately above them. Being arrived at the front wall of the brick-work, it there rises up again, and then passes  
along

along horizontally between the two middle cylinders, and the two upper cylinders, till it comes to the back wall; and, passing up by the farther ends of the upper cylinders, it comes forwards horizontally, for the last time, in an arch, or vault of brick-work, which covers the two upper cylinders. Being arrived once more at the front wall of the brick-work, it there enters a canal, (furnished with a good damper) by which it goes off into a neighbouring chimney.

These cylinders are confined in their places by being placed in pairs, over each other, between two parallel vertical walls, which are built just so far asunder as to admit two cylinders, placed horizontally, by the sides of each other; and the flame is prevented from finding its way upwards between the two cylinders which lye by the sides of each other, or between the outsides of those cylinders and the sides of the vertical walls with which they are in contact, by filling up the joining between them with good clay, mixed with small pieces of fire-bricks.

The farther ends of all the cylinders are closed up, and all the tubes which are necessary for the admission of water, and for the passage of the steam, are fixed to a circular plate of metal which closes, (by means of flanches and screws) the front ends of the cylinders.

In consequence of this particular arrangement it will be perfectly easy to make all the cylinders of *cast-iron*, even when these boilers are destined



for steam-engines of the largest dimensions. The number of sets of cylindrical boilers, which in each case it will be necessary to put up, must be determined by the size of the cylinders, and by the quantity of steam that will be wanted. Six cylindrical boilers put up in a separate mass of brick-work, in the manner above described, I call *one set*.

It will always be found to be very advantageous to have at least three or four sets of cylindrical boilers to each steam engine, instead of having one set of larger cylinders; and this not only on account of the wear and tear of small fire-places being incomparably less expensive than in those which are large; but also on account of the economy of fuel which will be derived from that arrangement, and the great convenience that will be found to result from the use of small boilers, which may at any time be heated and made to boil in a very few minutes; and from the advantage of being able at all times to regulate the number of sets of boilers in use, to the load on the engine.

It is quite impossible to make a small fire in a large fire-place, without a great loss of heat; but by having a number of small separate fire-places, an engine may be made to work with a light load, with almost as small a proportion of fuel as when it is made to perform its full work.—But to return to our cylindrical boilers.

The two lower cylinders, and those two which lie immediately over them, being destined for the  
gene-

generation of steam, are kept constantly about half full of water, which water they receive, already hot, from the two upper cylinders; in which last the water should never boil.

These upper cylinders communicate, by an open pipe, with a reservoir of water which is situated several feet above them, consequently, as fast as they furnish water to the four cylinders which lie below them, that water, so furnished, is immediately replaced by water which comes from the reservoir above.

As the pipe which brings this water from the reservoir enters the cylinders some considerable distance below their centers, and as the pipes which convey the water from them to the cylinders below are fixed in their centers, as cold water is heavier than warm water, it is evident that the water which enters them cold from the reservoir, will take its place at the lower parts of these cylinders, while only the lighter, hot water, will be furnished to the cylindrical boilers below.

The method of regulating the admission of water into the boilers below, where the steam is generated, is so well known, that it would be superfluous to give a particular account of it.

In the set of boilers that has been put up at the house of the Royal Institution, the open ends of all the cylinders are on one side, that is to say, they all come through the *front wall* of the brick-work. This arrangement was rendered necessary  
in

in that particular case, by local circumstances ; it would however have been better if only the lower and upper pairs of cylinders had come through the front wall, and the open ends of the middle pair had passed through the back wall ; for in that case it would have been easier to provide a passage for the flame round the ends of the middle cylinders.

One evident advantage that will be derived from constructing steam-engine boilers on the principles here recommended is, their superior strength to resist the efforts of the steam ; which will render it possible to use very thin sheet-copper, or sheet-iron, in constructing them, when they are made of those materials. Another advantage will be the great facility of removing and repairing any of the cylinders which may happen to leak, or which may be found to be damaged, or worn out. When several sets of cylinders are put up for the same engine (which I would always recommend, even for engines of the smallest size) any of these occasional repairs may be made without stopping the engine.

If these cylindrical steam boilers should be found to be useful for steam engines, they cannot fail to be equally so for generating steam for heating dyers coppers by means of steam,—for bleaching by means of steam ; and in general for every purpose where steam is wanted in large quantities.

They must, I think, be peculiarly well adapted for dyers ; for as water less hot than boiling water

is frequently wanted by them in the course of their business, the upper cylinders will at all times afford a plentiful supply of warm water; which may, without the smallest inconvenience, be drawn off whenever it is wanted.

To prevent, in the most effectual manner, the loss of heat which is occasioned by the passage of steam through the safety-valve, that steam which so escapes out of the boiler may be carried off in a tube provided for that purpose, and conducted into the upper cylinders, or into the reservoir which feeds them. In doing this, care must be taken to cause the steam to *descend* perpendicularly from the height of eight or ten feet, before it enters the water where it is intended that it should be condensed; and the end of the tube through which the steam descends and enters the water, should be plunged to a certain depth below the surface of the water.

I shall finish this chapter, and conclude this essay, by giving a short description of two very simple contrivances, which have been put in practice at the house of the Royal Institution, and which have been found to be very useful. The one is a contrivance for preventing most effectually the bad effects of the alternate expansion and contraction by heat and cold of the metallic tubes which are used in conveying steam to a considerable distance; and the other is a substitute for safety-valves in an apparatus for heating rooms by means of steam.

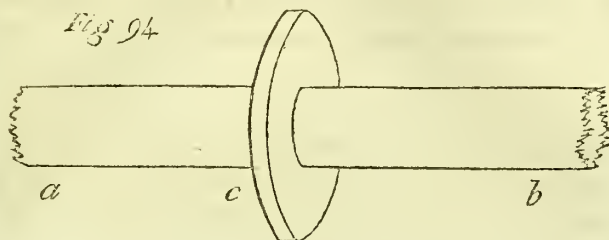
*Of the means that may be used for preventing metallic steam-tubes, of considerable length, from being injured by the alternate expansion and contraction of the metal by the different degrees of heat and cold to which those tubes are occasionally exposed.*

We will suppose the tube in question to be of copper, and eight inches in diameter (which is the size of that used for warming the Great Lecture Room at the Royal Institution). Let this tube be made in lengths of ten feet, and instead of joining the ends of these tubes together, immediately, to form one long tube, let a very short tube, or cylinder, of only one or two inches in length, and 24 inches in diameter, closed at each end with a flat circular plate of sheet-copper, like the head of a drum, be interposed between their joinings. These two circular sheets of copper, which form two ends of this very short cylinder, must be perforated in their centers with holes eight inches in diameter, to give a passage to the steam, and the ends of the tubes must be firmly fastened to them by means of flanches and rivets.

The following figure, which represents an outline of a portion of a steam-tube constructed in this manner, will give a clear idea of this contrivance.

*a, b,*





*a, b,* are portions of two of the tubes which are united together by means of the short flat cylinder *c*.

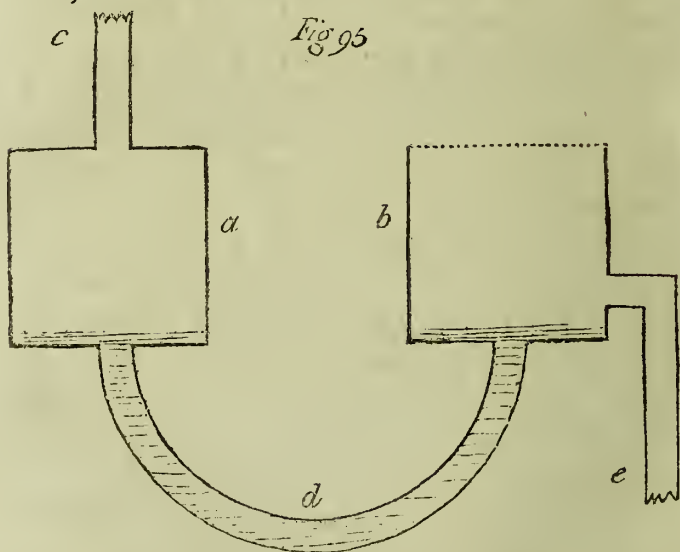
Now if we suppose one of these tubes (10 feet long) to be immoveably fixed *in the middle of its length* to a beam of wood, or to a solid wall, the increase or diminution of the length of each half of it, arising from its being occasionally heated to the temperature of boiling water, by steam, or cooled to the mean temperature of the air of the atmosphere, being free, will cause its two ends to push inwards, or to draw outwards, the two flat ends of the two neighbouring short cylinders to which they are attached; and as these short cylinders are 24 inches in diameter, while the tube is only 8 inches in diameter, the elasticity of the large circular thin plates of metal will allow it to be pressed inwards, or drawn outwards, without injury, much more than will be necessary in order to give room for the expansions and contractions of the tubes.

Hence it appears, that by this simple contrivance, steam may be conveyed to any distance, however great, in closed metallic tubes, without  
any

any danger of injury to the tubes from the expansions and contractions of the metal.

*A short description of a contrivance which serves instead of safety-valves for a steam-apparatus which is used for heating the great Lecture Room at the house of the Royal Institution.*

The following figure, which represents a vertical section of this contrivance, will give a clear idea of it, and of the manner in which it acts.



*a*, and *b*, are two cylinders of copper 6 inches in diameter; and 6 inches in length, placed in an erect position. The cylinder *a*, is closed both above and below;—the cylinder *b*, is closed below, but is open above.

The

The semi-circular tube *d*, which is represented filled with water, serves to connect the two cylinders together.

By the tube *c*, the water which results from the condensation of the steam in the steam-tubes which warm the room, returns to the reservoir which feeds the boiler. This water, after falling into the cylinder *a*, passes through the semi-circular tube *d*, into the cylinder *b*, and then goes off from that cylinder, and is conveyed, still warm, to the reservoir, by the tube *e*.

This simple apparatus serves as a safety-valve in the following manner: when the steam in the steam-tubes is redundant, it descends through the tube *c*, and forcing the water out of the semi-circular tube *d*, into the cylinder *b*, it follows it through that tube, and escapes into the open air through the open end of that cylinder. When the strength of the steam is sufficiently diminished, a small quantity of water, still remaining in the lower part of the cylinder *b*, returns back into the tube *d*, and cuts off the communication between the external air and the inside of the steam-tubes.

When, in consequence of the fire under the boiler being extinguished, or being much diminished, a vacuum begins to be formed in the steam-tubes, the external air pressing against the surface of the small quantity of water remaining in the lower part of the cylinder *b*, forces it through the semi-circular tube *d*, into the cylinder

der *a*, and following it into that cylinder, opens for itself a passage into the steam-tubes, and prevents their being crushed by the pressure of the atmosphere, on the condensation of the steam.

When the fire is gone out, and the whole apparatus becomes cold, the steam-tubes will be entirely filled with air.

When, on lighting the fire again, fresh steam is generated; as this steam enters the large steam-tubes in the *highest* or *most elevated* part of them, and as steam is specifically lighter than atmospheric air, the steam remains above the air which still occupies the steam-tubes, and accumulating there, presses this air downwards, and by degrees forces it out of the apparatus through the same passage by which it entered; the water in the semi-circular tube supplying the place of a valve,—or rather of two valves, in these different operations.

END OF THE TENTH ESSAY.

ESSAY XI.

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SUPPLEMENTARY OBSERVATIONS

CONCERNING

*CHIMNEY FIRE-PLACES.*



CONTENTS OF THIS ESSAY:

*Observations concerning Open CHIMNEY FIRE-PLACES.—An account of various Faults that have been committed by workmen, in England, who have been employed in altering Chimney Fire-places, and fitting them up according to the Method recommended by the Author, in his Fourth Essay.—Consequences which have resulted from these Mistakes.—Necessity of adhering strictly, and without deviation, to the Directions which have been given.—Those Particulars are pointed out in which Workmen are most liable to fail.*

## ESSAY XI.

*Of Chimney Fire-places.*

**I** WAS much flattered on my return to England, in September 1798, after an absence of two years, to find that the improvements in the construction of chimney fire-places, which I had recommended in my Fourth Essay, published in London in the beginning of the year 1796, were coming into use in various parts of the country; and I have since taken a good deal of pains to find out how they have answered, and what faults and imperfections have been discovered in them: And as the information I have obtained by these inquiries has enabled me to make several remarks and observations relative to the construction and management of these fire-places, that may be of use to those who have introduced them, or may be desirous of introducing them, I feel it to be my duty to lay them before the public.

It has been objected to these fire-places, that they sometimes occasion dust and ashes to come into the room when the fire is stirred. I have examined several fire-places said to have been fitted up on my principles, that have certainly had that fault; but I have commonly, I might say invariably found, that their imperfections have arisen from faults in their construction. Either the grate has been brought out *too far* into the room, or the opening of the fire-place in front has been left too wide—or too high—or the workman has neglected

to lower and to round off the breast of the chimney—or, what I have often found to be the case, several of these faults have existed together, in the same fire-place.

When the throat of a chimney is situated very high up above the mantle, and especially when the mantle and breast of the chimney, or the wall that reposes on the mantle, are very thin, workmen who are employed to alter chimnies, setting about the work with their minds strongly prepossessed with what they consider as the *leading principle* in the construction of these fire-places, namely, that the throat of the chimney should not be more than four inches wide, they are very apt to bring the grate too far forward. In dropping their plumb-line from the breast of the chimney, they do not reach up high enough into the chimney, but take a part of the breast, where it still goes on to slope backwards, for the bottom of the perpendicular canal of the chimney. They also very often commit another fault, not less essential, and that has the same tendency, in neglecting to *bring down the throat of the chimney nearer to the fire*, when it happens to be situated too high.

This I have not only recommended in my Essay on Chimney Fire-places, but have given the most particular directions how it is to be done (see Essay IV. page 362) and to mark the importance of the object still more strongly, have accompanied those directions by an engraving.

It is indeed a very important point, that the  
throat

throat of the chimney should be near the fire, and it should always be carefully attended to. It is likewise very important to "*round off the breast of the chimney*;" though this I find is very often entirely neglected, even by workmen who have had much practice in the construction of the fire-places I have recommended.

The breast of a chimney should always be rounded off in the neatest manner possible, beginning from the very front of the lower part of the mantle, and ending at the narrowest part of the throat of the chimney, where the breast ends in the front part of the perpendicular canal of the chimney. If the under surface of the mantle is flat and wide, it will be impossible to round off the breast properly; and that circumstance alone renders it indispensably necessary, in those cases, to alter the mantle, or to run under it a thinner piece of stone, or a thin wall of bricks, supported on an iron bar, in order that the breast of the chimney may be brought to be of the proper form, and the throat of the chimney may be brought into its proper situation.

If the under side of the mantle be left broad and flat, it is easy to perceive that the cloud of dust or light ashes, that rises from a coal fire nearly burnt out, when it is violently stirred about with a poker, striking perpendicularly against this flat part of it, must unavoidably be beat back into the room; but when the breast of the chimney is properly rounded off, the ascending cloud of

dust and smoke more easily finds its way into the throat of the chimney, and is even directed and assisted in some measure by the warm air of the room that gets under the mantle, and is going the same way.

Another very common fault that I have observed in chimney fire-places, that have been altered on what have been called my principles, and which has a direct tendency to bring dust, and even smoke, into the room, is the sloping of the covings too much, and leaving the opening of the fire-place in front too wide. I have said, in my Essay on Chimney Fire-places, that where chimnies are well constructed, and well situated, and have never been apt to smoke, in altering them the covings may be placed at an angle of 135 degrees with the back; but I have expressly said that they should never exceed that angle, and have stated at large the bad consequences that must follow from making the opening of a fire-place very wide, when its depth is very shallow, (see page 338.) I have also expressly said, (page 358) that for chimnies that are apt to smoke, the covings should be placed *less obliquely*, in respect to the back, than in others that have not that fault. But most of the workmen who have altered chimnies, seem to have paid little attention to these distinctions, and I have frequently found, and sometimes in fire-places that have been remarkably shallow, that the covings have been placed at an angle even more oblique than that above-mentioned.

Another



Another cause that sometimes has considerable effect in bringing dust and smoke into rooms, from the fires that are made in them, is the great nicety with which the doors and windows are fitted in their frames, which prevents a sufficient quantity of fresh air from coming into the room, to supply a brisk current up the chimney. It is however evident, that all the alterations in fire-places on the common construction, that have been recommended in order to improve them, must tend directly and very powerfully to lessen this evil; but nothing will so completely remedy it as lowering the mantle, and diminishing the width of the fire-place.

How many fire-places in close rooms have been cured completely of throwing puffs of smoke and dust into the room, merely by placing a register-stove in them? But there is surely nothing peculiar to a register-stove that could enable it to perform such a cure, but merely as it serves to diminish the width and height of the opening of the fire-place; and how much easier could this be done with marble, or other stone, or with bricks and mortar, plaistered over and encrusted in front with proper ornaments in stucco, or in artificial stone?

I am the more anxious that something of this sort should be introduced, as the openings of chimney fire-places are in general certainly too wide, and too high, and as I am convinced that there is no way of reducing them to a proper size, that

would be so cheap, or more effectual, or that could be made more ornamental.

Those who are fond of the glitter of polished steel, and have no objection to the expense of it, or to the labour that is required to keep it bright, may surround their fire-places *in front* with a border of it, for *there* it will do no harm, and may use grates and fenders of the most exquisite workmanship; but if they wish to have a pleasant, cheerful, and economical fire, the covings of their fire-places must be placed obliquely, and they must not be constructed of metal; and if the sides and back of the grate be constructed of fire bricks instead of iron, the fire will burn still brighter, and will send off considerably more radiant heat into the room.

I have abundant reason to think, that if in constructing or altering chimney fire-places, the rules laid down in my Essay on that subject are *strictly* adhered to, chimnies so fitted up will very seldom be found either to smoke, or to throw out dust into the room; and should they be found to have either of these faults, there is a remedy for the evil, as effectual, as it is simple and obvious: *Bring down the mantle, and the throat of the chimney lower; and if it should be found necessary, reduce the width of opening of the fire-place in front, and diminish the obliquity of the covings.*

These alterations will certainly be effectual, to prevent either smoke or dust from coming into

the room *when there is a fire burning in the grate*; but it sometimes happens, and indeed not unfrequently, that dust and soot are drawn down a chimney in which there is no fire, to the great annoyance of those who are in the room, and to the great damage of the furniture. When this happens, it is commonly occasioned by a very strong draught up *another chimney*, in which there is a fire, in an adjoining room, and when that is the case, the most simple remedy is to alter that other chimney, and constructing its fire-place on good principles, to reduce its throat to reasonable dimensions. But if the passage of the air down a chimney in which there is no fire, is occasioned by strong eddies of wind, there is no remedy for that evil but placing a chimney pot, of a peculiar construction, on the top of the chimney, which shall counteract the effects of those eddies, or by closing up the throat of the chimney occasionally, by a door made for that purpose of sheet iron.

If the door-way that is left in the back of the fire-place for giving a passage to the chimney sweeper, instead of being closed with a tile, or with a flat piece of stone, set in a groove made to receive it, according to the directions given in my Fourth Essay, it be closed with a flat piece of cast iron, or of plate iron, fixed at its lower end, to the lower end of the door-way, by a hinge, or moveable on two gudgeons; this plate may easily be so contrived as to serve occasionally as a register,

gister, or door, for diminishing, or closing, the throat of the chimney.

As this plate, situated at the *back part* of the chimney, could not produce any of those bad effects, that have with reason been attributed to the registers of common register stoves, (which are placed on the breast of the chimney) it appears to me to be very probable, that it would be found useful as a register for occasionally altering the size of the throat of the chimney, and regulating its draught; as well as for occasionally closing up that passage intirely. It would certainly be worth while to try the experiment.\*

Before I quit this subject, I must mention another fault, which workmen employed in altering chimney fire-places, that are furnished with grates or stoves with sloping backs, are very apt to make. They leave the back of the grate in its place, and instead of carrying up the back of the fire-place perpendicularly *from the bottom of the grate*, they first begin to carry it up perpendicularly from the top of the iron plate that forms the back of the grate; and as this plate not only slopes backwards considerably, but rises several inches above the level

\* Since the introduction of the cottage and gridiron grates, this contrivance has come into very general use, and experience has shewn it to be extremely useful. I would strongly recommend it to those who fit up chimney fire-places on these principles, never to omit this register; it costs a mere trifle, and is very useful on many accounts.

level of the upper bar of the grate, this necessarily throws the fire very far into the room. This tends to bring both smoke and dust into the room, not only because it brings the fire too far forward, but also because it occasions the air of the room, that slips in by the sides of the covings, to get behind the current of smoke that rises perpendicularly from the fire, which air frequently crowds the smoke forward, and causes it to strike against the mantle. This is a great fault, and I am sorry to say, that I have found it very common in many parts of England, where attempts have been made to introduce the fire-places I have recommended. Where grates *with sloping backs* are used in fitting up these fire-places, these backs must either be taken quite away, or bricked up, and the new back part or back wall of the fire-place, must be made to serve as a back for the grate, against which the burning fuel is laid.

As I am giving an account of the mistakes that have been made by some of those who have been employed in fitting up chimney fire-places on the principles I have publicly recommended, it will naturally be expected that I should take some notice of those numerous *improvements* that have been announced to the public, said to have been made in stoves, grates, &c. to which advertisers in the newspapers have thought proper to affix my name. As I am extremely anxious not to injure any man, either in his reputation for ingenuity, or in his trade, or in any other way, I shall not say one

word



word more on this subject, than what I feel it to be my duty to the public to declare, namely, that I am not the inventor of any of those stoves or grates, that have been offered to the public for sale, under my name.

Having mentioned the inconveniences that sometimes arise from doors and windows being fitted to their frames with so much nicety, as not to give a sufficient passage to air from without, to get into the room to supply the current up the chimney, which must always exist when a fire is burning in the room, I embrace this opportunity of mentioning a contrivance for remedying this defect, which I am persuaded would not only be found most effectual for that purpose, but would at the same time contribute very essentially to rendering dwelling houses more salubrious, and more comfortable, by facilitating the means of warming them more equally, and ventilating them more easily and more effectually.

In building a house an *air canal*, about twelve or fifteen inches square, in the clear, and open at both ends, may be constructed, in, or near the center of each stack of chimneys; and two branches from this air canal, both furnished with registers, may open into each of the adjoining rooms; one of these branches opening into the fire-place, just under the grate, and the other over the fire-place, and near the top of the room, or just under the ceiling. Each of these branches should be about four inches square, in the clear; and to prevent

vent the uncouth appearance of the open mouth of that which opens into the room over the fire-place, it may be masked by a medallion, a picture, or any other piece of ornamental furniture proper for that use, placed before it at the distance of one or two inches from the side or wall of the room.

The bottom of this *air tube* should reach to the ground, where it should communicate freely with the open air of the atmosphere, but it should not rise quite so high as the chimneys (or canals for carrying off the smoke) are carried up, but should end (by lateral openings, communicating with the air of the atmosphere) immediately above the roof of the house.

If this air tube be situated in the middle of a building, it is evident that an horizontal canal or tube of communication must be carried from its lower orifice to some open place without the building, in order to establish a free circulation of fresh air, both upwards and downwards, in the *air tube*. I say both *upwards* and *downwards*, for sometimes the current of air in the tube will be found to set upwards, and sometimes downwards. Its direction will depend on the winds that happen to prevail, or rather on the eddies they occasion in the air out of doors in the neighbourhood of the buildings, and it is no small advantage that will arise from leaving both ends of the air-tube open, that the tube will always be supplied with a sufficiency of air, whatever eddies the winds may occasion. It is easy to perceive how powerfully this must operate,

rate, to prevent those puffs of smoke which, in high winds, are frequently thrown into some rooms by the eddies, and the partial rarefactions of the air that they occasion; but this is far from being the only or the most important of the advantages that will be derived from this air tube. Those who consider what an immense quantity of air is required to supply the current that sets up the chimney of an open fire place, where there is a fire burning, must perceive what an enormous loss of heat there must be, when all this expence of air is supplied by the warmed air of the room, and that all this warmed air is necessarily and constantly replaced by the cold air from without, which finds its way into the room, by the crevices of the doors and windows. But all this waste of heat, or any part of it, at pleasure, may be prevented by the scheme proposed, for if the air necessary to the combustion of the fuel, and to the supplying of the current up the chimney, be furnished by the air-tube, the warmed air in the room will remain in its place; and as this will in a great measure prevent the cold currents from the crevices of the door and windows, the heat in the room will be the more equable, and consequently the more wholesome and agreeable on that account.

But there are, I am told, persons in this country, who are so fond of seeing what is called a great roaring fire, that even with its attendant inconveniences, of roasting and freezing opposite sides of the body at the same time, they prefer it to the genial

and equable warmth, which a smaller fire, properly managed, may be made to produce, even in an open chimney fire-place. To recommend the air-tubes to persons of that description, I would tell them, that by closing up, by means of its register, the lower branch of communication (that which ends just under the grate) and setting that situated near the top of the room wide open, they may indulge themselves with having a very large fire in the room *with little heat*, and this with much less inconvenience from currents of cold air from the doors and windows, than they now experience.

It is easy to perceive, that by a proper use of the two registers, together with a judicious management of the fire, the air in the room may either be made hotter, or colder;—or may be kept at any given temperature—or the room may be most effectually ventilated; and that this change of air may be effected, either gradually or more suddenly. And here it may perhaps be the proper place to observe, that in all our reasonings and speculations relative to the heating of rooms by means of open chimney fires, we must never forget that it is the *room that heats the air*, and not the air that heats the room.

The rays that are sent off from the burning fuel, generate heat, only *when* and *where* they are *stopped*, or *absorbed*, consequently they generate no heat in the air in the room, in passing through it, because they *pass through it*, and are not *stopped* by it, but, striking against the walls of the room, or against any solid

solid body in the room, these rays are *there* stopped and absorbed, and it is *there* that the heat found in the room is *generated*. The air in the room is afterwards heated by coming into contact with these solid bodies. Many capital mistakes have arisen from inattention to this most important fact.

It is really astonishing how little attention is paid to events which happen frequently, however interesting they may be as objects of curious investigation, or however they may be connected with the comforts and enjoyments of life. Things near us, and which are familiar to us, are seldom objects of our meditations. How few persons are there who ever took the trouble to bestow a thought on the subject in question, though it is, in the highest degree, curious and interesting.

END OF THE ELEVENTH ESSAY.



ESSAY XII.

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OBSERVATIONS

CONCERNING THE

SALUBRITY OF WARM ROOMS

IN

COLD WEATHER.

## CONTENTS OF THIS ESSAY.

*Of the SALUBRITY of WARM ROOMS.—A distinction ought to be made between FRESH, or COLD AIR, and PURE, or WHOLESOME AIR.—Streams of cold air are always pernicious.—They cannot be avoided in cold weather in rooms heated by a large open chimney fire.—The danger from these cold currents of air is greatest when we are least sensible of their existence.—This remarkable fact is explained, by shewing that we are not capable of feeling heat and cold at the same time.—Sudden changes from hot rooms to the cold air is not dangerous to health.—This is proved by the healthfulness of the Swedes and Russians, who inhabit very warm rooms in winter.—A warm room, by promoting a free circulation of the blood, gives that health and vigour which are necessary in order to support without injury occasional exposure to intense cold.*

## ESSAY XII.

*Of the Salubrity of Warm Rooms.*

**I**T is a question often discussed in this country, whether living in a warm room in winter be, or be not, detrimental to health?

There is no doubt whatever of the necessity of *pure* air for the support of life and health, but I really do believe that erroneous opinions are entertained by many people in this island, respecting the effects of that equal, and at the same time moderate heat, which can only be obtained in rooms where strong currents of air up the chimney are not permitted. Those who have been used to living in large apartments, in which the large fires that are kept up, instead of making the rooms equally warm, do little more than increase the violence of those streams of cold air, which come whistling in through every crevice of the doors and windows; when such persons come into a room in which an equal and genial warmth prevails in every part, struck with the novelty of the sensation that this general warmth produces, they are

very apt to fancy that the air is *close*, and consequently that it must be unwholesome, and are uneasy until a door or a window be opened, in order that they may get what they call *fresh* air.

But they do not seem to make a proper distinction between *fresh* air, and *pure* air. When they call for *fresh* air, they doubtless mean *purser* air. They certainly get *colder* air, but I much doubt whether they often get air that is more wholesome to breathe ; and it is most certain that the chilling streams and eddies that are occasioned in the room by the fresh air so introduced, are extremely dangerous, and often are the cause of the most fatal disorders.

It is universally allowed to be very dangerous to be exposed in a stream of cold air, especially when standing or sitting still ;—but how much must the danger be increased if one side of the body be heated by the powerful rays from a large fire, while the other is chilled by these cold blasts ? And there is this singular circumstance attending these chills, that they frequently produce their mischievous effects without our being sensible of them ; for as the mind is incapable of attending to more than one sensation at one and the same time, if the *intensity* of the sensation produced by the heat on the one side of the body be superior to that of the cold on the other, we shall remain perfectly insensible of the cold, however severe it may really be, and if we are induced by the disagreeableness of what we do feel to turn about, or  
change

change our position or situation, this movement will be occasioned, not by the cold, which we do not feel, but by the heat, which being superior in its effect upon us, engages all our attention. And hence we may account for those severe colds or catarrhs, which are so frequently gotten in hot rooms in this country by persons who are not conscious at the time of being exposed to any cold, but, on the contrary, suffer great and continual inconvenience from the heat.

I have said, that these colds are gotten in *hot rooms*, but it would have been more accurate to have said *in rooms where there is a great fire*—or where there is a *great heat*, occasioned by a great number of burning candles, or by a great number of persons crowded together,—for it is very seldom indeed that A ROOM is much heated in this country, and their being cold is the principal cause which renders partial heats that occasionally exist in them so very injurious to health.

The air of the room that comes into contact with the cold walls, and with the enormous windows, which, in open defiance of every principle of good taste, have lately come into fashion, is suddenly cooled, and being condensed, and made specifically heavier than it was before, in consequence of this loss of heat, it descends and forms cold streams, that are so much the more rapid and more dangerous as the partial heats in the room are more intense,—consequently they are the more



dangerous, as they are less liable to be observed or felt.

If to these cold currents which are generated in the room, we add those which come into it from without, to supply the enormous quantity of air that is continually going off by the chimney, when there is a great quantity of coals burning in an open grate, we shall not be surprised, that those who venture to go into such rooms without being well wrapped up in furs, or other warm cloathing, should be liable to take colds.

I never see a delicate young lady dressed in thin muslins, or gauzes, in the midst of winter, expose herself in such a perilous situation, without shuddering for the consequences. But how many young persons of both sexes do we find, of delicate habits, and particularly among the higher ranks of society?—And what vast numbers are carried off annually by consumptions!

It is well known, that this dreadful disorder is almost always brought on by colds, and that the cold of winter is commonly fatal to consumptive people; but why should the inhabitants of this island be so peculiarly subject to these colds? Is it not highly probably that it is because they do not take proper care to prevent them?—For my part I declare, in the most serious manner, that I have not the smallest doubt that this is really the case.

Much has been said of the supposed danger of keeping rooms warm in winter, on account of the  
necef-

necessity most people are under of sometimes going into the cold air. But how many proofs are there, that these sudden transitions from heat to cold, or from cold to heat, are not attended with danger, if care be taken to be properly clothed, and if the heats and colds are not partial?

How very hot do the Swedes and the Russians keep their houses during the long and severe frosts that prevail in winter in those countries? and yet no people are more strong and healthy than they are, nor are there any less liable to catarrhs and consumptions.

It is the very warm rooms in which this hardy race of men spend much of their time in winter, (which, by promoting a free circulation of their blood gives them health and strength) that enables them to support, without injury, exposure, *for short periods*, to the most intense cold.

In Germany, the rooms of people of rank and fashion are commonly kept, in winter, at the temperature of about 64° or 65° of Fahrenheit's thermometer (the dwellings of the peasants are kept much hotter); but though the ladies in that country are, from their infancy, brought up with the greatest care, and are as little exposed to hardships, as the women of condition in this, or in any other country, they find no inconvenience in going out of these warm rooms into the cold air. They even frequent the plays and the operas, and go on strolling parties, during the severest frosts, and spend one whole month in the depth of winter (in

the season of the carnival) in one continued round of balls and masquerades. And, what may perhaps appear to many still more incredible, they seldom fail, whatever the severity of the weather may be, to spend half an hour every morning in a cold church.

But if in Germany, where the winters are incomparably more severe than they are in this country, persons tenderly brought up, and of delicate habits, find no inconvenience whatever in living in warm rooms, and in going from them into the cold air, why should warm rooms be unwholesome in this country?

There cannot surely be any thing injurious to health in the genial warmth of  $60^{\circ}$  or  $65^{\circ}$ ; and if *pure air* for respiration is what is wanted, the great height of our rooms in England secures us against all danger from that quarter.

The prejudice in this country against living in warm rooms in winter, has arisen from a very natural cause; and though the prejudice is general, and very deeply rooted, as its cause is known to me, I really have hopes that I shall be able to combat it with some success. I am perfectly sure that justice will be done to the purity of my intentions in engaging in this arduous undertaking, and *that* I look upon as a circumstance of no small importance, especially when I consider that it can hardly escape the observation of my reader, that few persons can be better qualified by their own experience, to give an opinion on any subject,  
than

than I happen to be to give mine on that under consideration.

I went to Germany many years ago, with as strong a prejudice against warm rooms as any body can have, but after having spent twelve winters in that country, I have learnt to know that warm rooms are very comfortable in cold weather, and that they certainly tend to the preservation of health:

Having occupied a very large house, in which there are several apartments that are furnished with open chimney fire-places, I have had an excellent opportunity of making experiments of the comparative advantages and disadvantages of warming rooms with them, and with stoves, and my opinions on these subjects have not been hastily formed, but have been the result of much patient investigation. They have been the result of conviction.

Were there any thing *new* in what I recommend, I might be suspected of being influenced by a desire to enhance the merit of my own discoveries or inventions; but as there is not, this suspicion cannot exist; and I may fairly expect to be heard with that impartiality which the purity of my intentions give me a right to expect.

It may perhaps be asked by some, what right I have to meddle at all in a business that does not concern me personally? Why not let the people of this country go on quietly in their own way, without tiring them with proposals for introducing changes

changes in their customs and manner of living, to which they evidently have a decided aversion?

To such questions and observations as these I should make no reply, but should still feel anxious to promote, by every means in my power, all such improvements as tend to increase the comforts and innocent enjoyments of life, from whatever quarter they might come.

If it be wisdom to choose what is good, it must be folly to refuse what is advantageous to us;—and if liberality be an ornament to a respectable character, it is weakness to be ashamed of adopting the useful inventions of our neighbours.

I am not without hopes, that, at some future period, houses in England will become as celebrated for warmth and comfort, as they are now for neatness, and for the richness and elegance of their furniture.

However habit may have reconciled us to it, or rendered us insensible to its effects, *cold* is undoubtedly a very great physical evil. It may be, and no doubt is, productive of good in some way or other, but that is not a sufficient reason why we should not endeavour to guard ourselves against its painful and disagreeable effects. Their being painful is a proof of their being hurtful, and it is moreover a kind intimation to us of the presence of an enemy, to be avoided.

We may, no doubt, by habit, inure ourselves to cold in such a manner as to render our bodies in some degree insensible to it; but does it necessarily



farly follow that by these means its pernicious effects on us are prevented, or even diminished? I see no reason for supposing this to be the case.

If inuring to cold were a sufficient preservative against its bad effects, this method (which, certainly, would be the most economical) would, we have reason to think, have been adopted by Providence in respect to brute animals; but beasts and birds which pass the winter in cold climates, are all furnished with warm winter garments.

What provident nature furnishes to brute animals, man is left to provide for himself, or to supply the want of it by his ingenuity.

If living in cold rooms really tended to give strength and vigour to the constitution, and to enable men to support without injury the piercing cold of winter, we might expect that the dwellings of the inhabitants of the Polar regions would be kept at a very low temperature; but this is so far from being the case in fact, that we always find the hottest rooms in the coldest climates.

If the transition from a hot room to the cold air were so dangerous as it is represented, how does it happen that Swedes and Laplanders, who live in rooms that are kept excessively hot, do not take cold when they expose themselves to the intense cold of their winters?

Swedes and Russians, who pass the winter in England, never fail to complain of the uncomfortable coldness of our houses, and seldom escape catarrhs, and other disorders occasioned by cold. And the  
sickness

sickness and mortality which prevailed among the Russian soldiers and sailors, who wintered in this country in the years 1798 and 1799, were generally, and no doubt justly ascribed to their being unable to support the cold to which they were exposed in our barracks, and in our hospitals; a degree of cold to which they never had been accustomed, *within doors*, and which to them appeared to be quite insupportable.

These are strong facts; and the evidence they afford in the case under consideration, is pointed, and appears to me to be incontrovertible. There are many other similar facts that might be adduced in support of the position we are endeavouring to establish.

It has often been objected to warm rooms, that the air in them is always confined, and consequently unwholesome; but no argument more perfectly groundless and nugatory was ever adduced in support of a bad cause.

When, in cold weather, a room is kept warm, the air in it, so far from being confined, is continually changing. Being specifically lighter (in consequence of its being warm) than the air without, it is impossible to open and shut a door without vast quantities of it being forced out of the room by the colder air from without, which rushes in; and if at any time it be required to ventilate the room in so complete a manner that not a particle of the air in it, shall remain in it, this may be done in less time than one minute, merely by letting

ting down the top of one of the windows, and at the same time opening a door which will admit the external colder, and heavier air. And it must not be imagined that the room will be much cooled in consequence of this complete ventilation.—So far from it, a person returning into it, three or four minutes after it had been ventilated, and the air in it totally changed, would not find its temperature sensibly altered.

The *walls of the room* would still be nearly as warm as before, and the radiant heat from those walls, passing through the transparent air of the room, without any sensible diminution of their calorific powers, would produce the same sensation of warmth as they did before. And even the cold air admitted into the room would in a few minutes become really warm. And as the specific gravity of air is so very small, compared with that of the dense solid materials of which the walls, floor, and ceiling of the room are constructed, the warming of this air will not sensibly cool the room.

Hence we see how easy it is to ventilate warm rooms, in cold weather, and also how impossible it would be to live in such a room, without the air in it being perpetually changed, and replaced with fresh and pure air from without.

It is those who inhabit cold rooms who are exposed to the danger of breathing confined air; for it would be in vain to open the doors and windows

dows of such an apartment; if the air in it is as cold, and consequently just as heavy, as that without, there is no physical reason why it should move out of its place. Part of it may indeed be blown out by a wind, or, without opening the doors and windows, a *part of it* may be forced up the chimney, if there be a fire burning in it; but this kind of ventilation is not only dangerous in a very high degree, to the health of those who are in the room, but it is also partial, and very incomplete. As the currents of cold air which supply the draught of an open chimney fire are confined to the bottom of the room, below the level of the mantel of the fire-place, the same air may remain for weeks in the upper parts of the room, and perhaps for a much longer time in some remote corner, far from the fire.

I think enough has now been said to prove to the satisfaction of every reasonable person who is disposed to listen, and willing to be convinced, that the air in rooms properly and equally warmed in cold weather cannot be confined and contaminated;—and that inhabiting warm rooms in winter, so far from rendering persons weak and unable to bear the cold on going abroad, is the best preservative against the bad effects of occasional exposure to cold.

If there are any persons who like cold rooms, and partial chilling streams of cold air, and prefer them to the genial warmth of a mild and equal  
tempe-

temperature, that choice must be considered as a matter of *taste*, about which there is no disputing.

There is a simple experiment, easily made, and no wise dangerous, which shews, in a sensible and convincing manner, that warmth prepares the body to bear occasional cold without pain and without injury : let a person in health, rising from a warm bed, after a good night's rest, in cold weather, put on a dry warm shirt, and dressing himself merely in his drawers, stockings, and slippers ; let him go into a room in which there is no fire, and walk leisurely about the room for half an hour, or let him sit down, and write or read during that time, he will find himself able to support this trial without the smallest inconvenience ; the cold to which he exposes himself will hardly be felt ; and no bad consequences to his health will result from the experiment. Let him now repeat this experiment under different circumstances. In the evening of a chilly day, and when he is shivering with cold, let him undress himself to his shirt, and see how long he will be able to support exposure to the air in a cold room in that light dress.

There is another remarkable fact, with which I was made acquainted by an eminent Physician of London, Dr. BLANE, which can hardly be accounted for but on a supposition that heat prepares and enables the body to support cold. Those persons who, after having remained several years in the hot climates of India, return to reside  
in



in this country, do not feel near so much inconvenience from the cold of our climate the first year after their return, as they do the second.— If they would be persuaded to live in warm rooms, *when they are within doors*; and make a free use of the warm bath, they *never* would feel any inconvenience from it; and they might with safety take much more exercise in the open air than they now do.

Occasional exposure to cold, when the body is prepared to support it, so far from being dangerous, or injurious to health, is salubrious in a high degree.

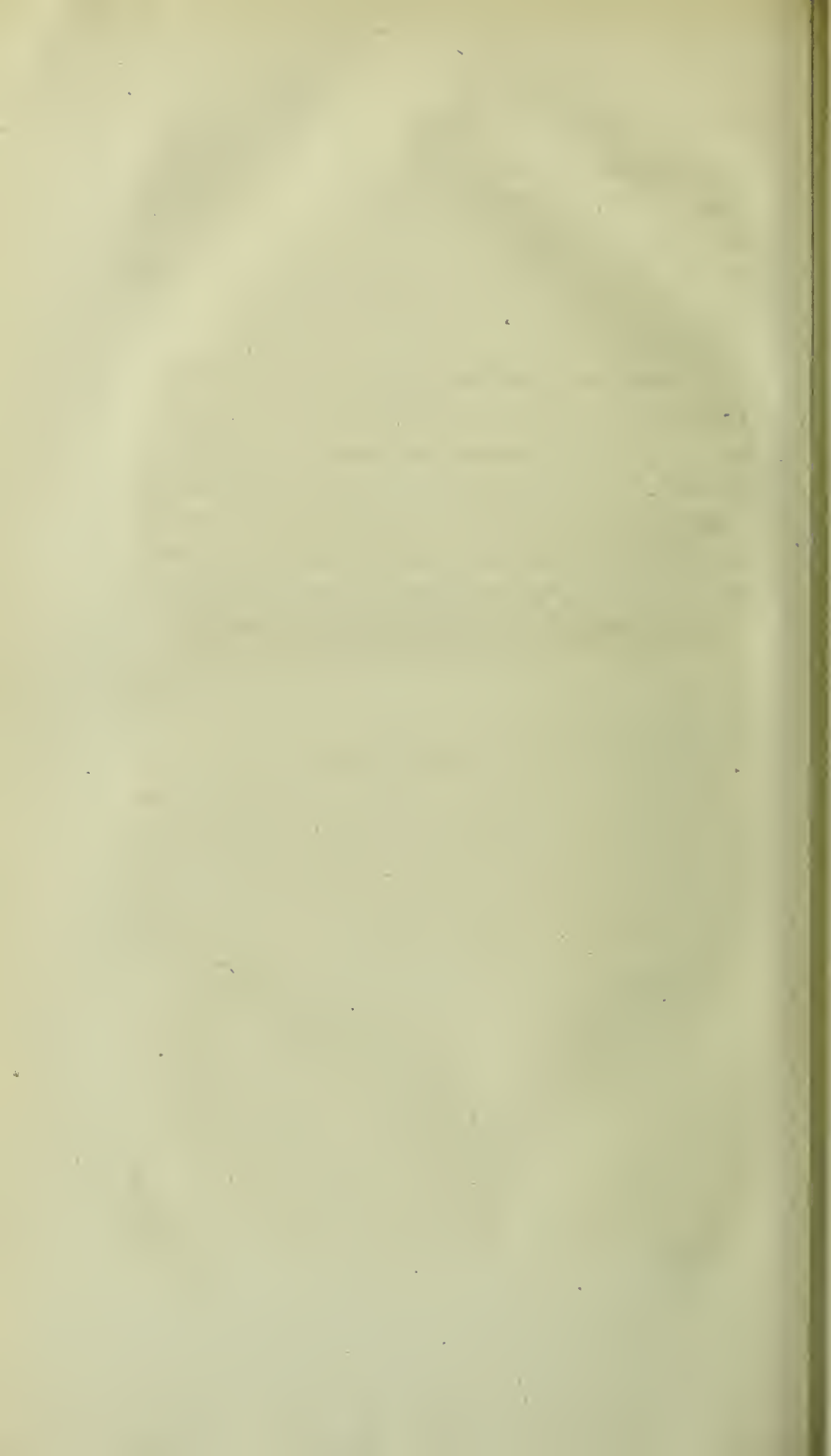
It is in order that people may be enabled to go abroad frequently, and enjoy the fine bracing cold of winter, that I am so anxious that they should inhabit warm comfortable rooms, when they are within doors. But if, during the time when they are sitting still, without exercise, the circulation of the blood is gradually and insensibly diminished by the cold which surrounds them, and above all, by the cold currents of air in which they are exposed, it is not possible that they should be able to support an additional degree of cold without sinking under it.

They are like water, which, by long exposure to moderate cold, in a state of rest, has been slowly cooled down below the freezing point; the smallest additional cold, or the small agitation, changes it to ice in an instant; but water at a higher temperature, and full of latent heat, will support the

same degree of severe frost, for a considerable time, without appearing to be at all affected by it.—The more attentively this comparison is considered, the more just will it be found; and the more conclusive will be the inferences that are derived from it.

If man has been less kindly used than brute animals by being sent naked into the world, without a garment to cover and defend from the inclemency of the seasons, the power which has been given him over FIRE has made the most ample amends for that natural deficiency; and it would be wise in us to derive all possible advantages from the exercise of the high prerogative we enjoy.

END OF THE TWELFTH ESSAY.



ESSAY XIII.

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OBSERVATIONS  
CONCERNING THE  
SALUBRITY OF WARM BATHING,  
AND  
THE PRINCIPLES  
ON WHICH  
WARM-BATHS  
SHOULD BE CONSTRUCTED.

## CONTENTS OF THIS ESSAY.

*The salubrity of warm bathing has been universally acknowledged in all ages.—It has been practised in all climates.—An account of a circumstance by which the author was accidentally induced to turn his attention to this subject.—Good effects experienced by him from a very free use of the warm bath.—It is found that the use of the warm bath, so far from rendering persons peculiarly liable to take cold on going into the cold air, actually strengthens the constitution, and diminishes the danger attending occasional exposure to cold.—Exclusive of the salutary effects of warm bathing, the practice is well deserving of being recommended on account of the delightful enjoyment which it affords.—Probability that the best method of fitting up and using warm baths is not known in this country.—Water in large quantities is not so necessary in a warm bath, as is generally supposed.—Probability that it is the warmth, and not the water, to which the salutary effects resulting from warm bathing ought to be ascribed.—Danger attending the use of tepid and temperate baths.—An account is given of the result of an interesting experiment.—Great ingenuity displayed in the construction of the hot baths of the Russians.—A sketch of a plan for an elegant bath.—Plan of a bath on a more economical scale.—Description (from M. Savary) of the manner in which the warm bath is used in Egypt, and of the pleasurable sensations which result from the use of it.*



## ESSAY XIII.

*Of the Salubrity of Warm Bathing.*

**H**AD I any hopes of being able, by any thing I could say, to prevail on the inhabitants of this island, to adopt more generally a practice which so many nations have considered as a most rational luxury, and which, no doubt, is as conducive to health, as it is essential to personal cleanliness, I should think my time well employed were I to write a volume in recommendation of warm bathing: but I am sensible, that after all that has already been said on that subject, by ancient and modern writers;—by historians, and by medical men;—what I could add would be of little avail. The subject is, however, so intimately connected with that treated in the preceding Essay (XII.) that I may, perhaps, without any impropriety, take the liberty to make a few observations concerning it.

If a perfectly free circulation of the blood, brought on and kept up for a certain time, without any violent muscular exertion, and consequently without any expence of strength, be conducive to health, in that case warm bathing must be wholesome; and so far from weakening the constitution, must tend very powerfully to strengthen it.

Among those nations where warm bathing has been most generally practised, and where the effects of it have of course been best known, no doubts have ever been entertained of its being very beneficial to health; and nobody can doubt of its being pleasant and agreeable in a high degree.

Had warm bathing never prevailed but in certain climates, doubts might be entertained of its *general* usefulness; but so many nations,—remote from each other,—and inhabiting countries extremely different, not only in respect to climate, but also in respect to situation and produce, and where manners and customs have been extremely different in all other respects, have practised it,—that we may safely venture to pronounce warm bathing to be useful to man.

It was by accident I was led, about two years ago, to consider this subject with that attention which it appears to me to deserve; and I then made an experiment on myself, the result of which I really think very interesting, and of sufficient importance to deserve being made known to the public.

The waters of Harrowgate, in Yorkshire, having been recommended to me by my physician, I went there in the month of July 1800, and remained there two months. I began with drinking the waters, at the well, every morning, and with bathing in them, warmed to about 96° of Fahrenheit's thermometer, every third day, at my lodgings.

At first, I went into the bath at about ten  
o'clock

o'clock in the evening, and remained in it from ten to fifteen minutes; and immediately on coming out of it, went to bed, my bed having been well warmed, with a view to preventing my *taking cold*.

Having pursued this method some time, and finding myself frequently feverish and restless after bathing, I accidentally, in conversation, mentioned the circumstance to an intelligent gentleman, who happened to lodge in the house, and who had long been in a habit of visiting Harrowgate every year. He advised me to change my hour of bathing; and to stay longer in the bath; and, above all, to avoid going into a warmed bed on coming out of it. I followed his advice, and shall have reason, all my life, to thank him for it.

I now went into the bath regularly every third day, about two hours before dinner, and staid in it half an hour, and on coming out of it, instead of going into a warmed bed, I merely had myself wiped perfectly dry with warmed cloths, in a warmed room, adjoining to the bath; and dressing myself in a bed-gown, which was moderately warm, I retired to my room, where I remained till dinner time, amusing myself with walking about the room, and with reading, or writing, till it was time to dress for dinner.

The good effects produced by this change of method were too striking not to be remarked, and remembered. I was no longer troubled with any of those feverish heats after bathing, which I experienced

rienced before; and so far from feeling *chilly*, or being particularly sensible to cold on coming out of the bath, I always found myself less sensible to cold after bathing than before. I even observed repeatedly and invariably, that the glow of health, and pleasing flow of spirits, which resulted from the full and free circulation of the blood, which bathing had brought on, continued for many hours; and never was followed by any thing like that distressing languor which always succeeds to an artificial increase of circulation, and momentary flow of spirits, which are produced by stimulating medicines.

I regularly found that I had a better appetite for my dinner on those days when I bathed, than on those when I did not bathe,—and also, that I had a better digestion, and better spirits; and was stronger to endure fatigue; and less sensible to cold in the afternoon and evening.

As these favourable results appeared to be quite regular and constant, I was induced to proceed to a more decisive experiment. I now began to bathe every *second day*; and finding that all the advantageous effects which I had before experienced from warm bathing still continued, I was encouraged to go one step further; and I now began to bathe *every day*.

This experiment was thought to be very hazardous, by many persons at Harrowgate, and even by the physician, who did not much approve of my proceedings; but as no inconvenience of  
any

any kind appeared to result from it, and as I found myself growing stronger every day, and gaining fresh health, activity, and spirits, I continued the practice, and actually bathed *every day*, at two o'clock in the afternoon, for half an hour, in a bath at the temperature of 96° and 97 degrees of Fahrenheit's scale, during *thirty-five days*.

The salutary effects of this experiment were perfectly evident to all those who were present and saw the progress of it, and the advantages I received from it have been permanent. The good state of health, which I have since enjoyed, I ascribe to it intirely.—But it is not merely on account of the advantages which I happened to derive from warm bathing, which renders me so warm an advocate for the practice.—Exclusive of the wholesomeness of the warm bath, the luxury of bathing is so great, and the tranquil state of mind and body which follows it, is so exquisitely delightful, that I think it quite impossible to recommend it too strongly, if we consider it merely as a rational and elegant refinement.

I am persuaded, however, that we are very far, in this country, from understanding the best method of fitting up warm baths, and of using them in the most comfortable and advantageous manner. It appears to me to be quite evident that it is not the water, but the *warmth* to which most, if not all the good effects experienced from warm bathing, ought to be ascribed.

Among those nations where warm bathing has  
been



been most generally practised, water has seldom been employed, except occasionally, and merely for washing and cleaning the skin: and though washing in warm water is pleasant, and is, no doubt, very wholesome; yet, remaining with the whole body, except the head, plunged, and immersed in that liquid for so great a length of time as is necessary, in order that a warm bath may produce its proper salutary effects, is not very agreeable, nor is it probably either necessary or salutary.

The manner in which a warm bath operates, in producing the pleasant and salutary effects which are found to be derived from it, appears to me to be so evident as to admit of no doubt or difference of opinion on that subject.

The genial warmth which is applied to the skin, in the place of the cold air of the atmosphere, by which we are commonly surrounded, expands all those very small vessels where the extremities of the arteries and veins unite, and by gently stimulating the whole frame produces a free and full circulation, which, if continued for a certain time, removes all obstructions in the vascular system, and puts all the organs into that state of regular, free, and full motion, which is essential to health, and also to that delightful repose, accompanied by a consciousness of the power of exertion, which constitutes the highest animal enjoyment of which we are capable.

If this statement be accurate, it cannot be difficult to explain, in a manner perfectly satisfactory,  
why

why a warm bath is often found to produce effects when first used, and especially by those who stay in the bath for too short a time, which are very different from those which it ought to produce, and which it cannot fail to produce when properly managed. We shall likewise be enabled to account for the feverish symptoms, which result from going out of a warm bath into a warmed bed.

The beginning of that strong circulation, which is occasioned on first going into a warm bath, is an effort of nature to remove obstructions; and if time be not given to her to complete her work, and if she be checked in the midst of it, the consequences must necessarily be very different from those which would result from a more scientific and prudent management. Hence we see how necessary it is to remain in a warm bath a sufficient time;—and above all, how essential it is that the bath should be *really warm*, and not tepid, or what has been called *temperate*.

When we consider the rapidity with which water carries off heat from any body hotter than it, which is immersed in it, we shall find reason for astonishment that any person, even the strongest man in a state of the highest health, is able to support the loss of heat which must necessarily result from lying for half an hour quite motionless in a tub of water, at the temperature of 55 or 60 degrees; and yet, if I am rightly informed, baths at that temperature have sometimes been ordered  
by

by physicians, and even for persons of delicate constitutions.

Because we are able to support that degree of cold, without injury, *in air*, that is very far indeed from being a good reason for concluding that *water* at that temperature would not be hurtful; for water is 800 times more dense than air, and consequently when it is cold, must deprive our bodies of heat, when we are immersed in it, with infinitely greater rapidity than air, at the same temperature, can do.

Having reason to think that physicians in general are not sufficiently aware of the very great difference there is in the powers of these two fluids to *carry off* heat when they are both at the same temperature;—and having myself been a witness, more than once, to very alarming consequences which have resulted from the use of what was called a *tepid bath*, I cannot resist the inclination I feel to avail myself of this opportunity of calling the attention of medical men to a circumstance which is, most undoubtedly, of very serious importance.

When we go into a bath at the temperature of about 96 degrees (which is blood heat) though the water at first may seem warm to us, and even hot, yet it is not capable of communicating much heat to us, for our bodies being at the same temperature, except it be perhaps at the very surface of the skin (where the nerves of feeling are most plentifully distributed) there is no reason why heat should pass out of the water into us; but if the  
water

water be only a few degrees below the temperature of the blood, though it may feel warm when we first go into the bath, yet that sensation will soon be followed by one of a very different nature; and the water will carry off heat very rapidly from the surface of the body.

A rapid cooling of the body, by carrying off, by a mechanical process, the heat generated in the body by the action of the vital powers, may, or may not, be adviseable in certain cases. That is a question of nice discrimination, and one upon which I am perfectly sensible that I am not qualified to decide: but I may be allowed to point out physical consequences, not very obvious, and consequently not likely to be subjects of meditation and investigation, which ought certainly to be rightly understood.

There is one observation more respecting tepid and temperate baths, which appears to me to be deserving of particular attention, and that is, the state of *inaction* in which a person commonly remains in such a bath, and the probable consequences of inaction under such circumstances. Swimming is universally allowed to be an wholesome exercise, and there are few instances, I believe, of harm arising from it, even when the water has been at a much lower temperature than that of the blood; but I am far from being of opinion that remaining in the water, without any muscular exertion, would be found to be equally conducive to health.

Cold

Cold baths are perfectly different from hot baths, and tepid baths, and the intention of the physician in ordering them is also different. I am not prepared to explain the physical effects produced by a momentary plunge into cold water; and much less to give an opinion respecting the salubrity of the practice of cold bathing, or of its usefulness as a remedy for certain diseases.

But to return from these speculations to more interesting details—to the results of actual experiments.—During the thirty-five days that I continued to make daily use of a warm bath, I made a number of experiments on myself, in order fully to satisfy my own mind on several important points, respecting which I still had doubts remaining. Some of those experiments were certainly too hazardous to be reconciled to sober good sense, and to that prudent attention to the preservation of health, which every wise man would be ashamed of neglecting. But though I may be blameable for my temerity, and may even expose myself to ridicule by making a discovery of my rashness; yet I am so deeply impressed with the importance of the results of some of my experiments, that I cannot refrain from laying them before the public.

Having long entertained an opinion, that the most effectual means that can be used to prepare the body to support, without inconvenience, and without injury, these occasional exposures to cold, to which every person is liable who inhabits a cold country, is, by a proper application of warmth, and



without the fatigue of violent muscular exertion, to bring on, and keep up for a certain time, at certain intervals, such a full, strong, and free circulation and perspiration, as shall effectually remove, from time to time, all those gradual contractions and obstructions which chilling cold naturally produces, and give a new impulse to those actions in which life, health, and strength consist; I imagined that, if this opinion was well founded, the use of the warm bath, instead of rendering my habit more delicate, and making me more liable to take cold on exposing myself in the cold air, I should certainly find myself strengthened by it, and my constitution rendered more robust.

The first direct proofs I had, that this advantageous change had actually taken place in me, were accidental; and it was probably that discovery which induced and encouraged me to expose myself voluntarily to more severe trials.

I had, from the time of my first arrival at Harrowgate, been in a habit of retiring to my room towards evening every day, where I commonly spent an hour or more in reading or writing, and as I never had any fire in my room, I frequently felt myself quite chilled by the cold of the evening. At this time I bathed only once in three days; but after I had begun to go into the bath before dinner, I soon found that I was much less sensible to the cold of the evening on those days when I bathed, than on those when I did not bathe.

It

It was the discovery of this interesting fact which contributed much, and perhaps more than any thing else, to induce me to take the resolution, (which was considered as very violent and unadvised) of going into the bath every second day, and afterwards every day.

After I had continued to bathe every day for some time, I no longer felt the smallest inconvenience from the cold of the evening, though I frequently sat in my room with the windows open, when the weather was very cold and chilly, 'till it was so dark that I could neither see to read nor to write ; and when I joined the company below, I felt myself in high spirits, and never wanted an excellent appetite to my supper. My sleep was undisturbed and refreshing ; and every thing indicated the return of perfect health.

All these favourable appearances having continued for some time, and finding my strength to increase daily, I became more venturous, and frequently went out after it was dark, when the evening was cold and raw, and walked alone more than half an hour on the bleak dreary common, which lies before the house where I lodged (the Ganby Inn) to see if my constitution was really so much changed as to enable me to support that trial without taking cold.

I even returned on foot from the play-house, across the common, several times, in the evening, lightly dressed, when a cold wind blew over the common, and after I had suffered much from heat

in

in the theatre : but in none of these severe trials did I receive the smallest injury : I never too cold, nor did I experience any feverish heats, or restlessness, on going to bed after them. I call them *severe* trials, and as such they will doubtless be considered, when it is recollected, that when I arrived at Harrogate, I was far from being in a good state of health, (having never recovered from the dangerous illness I had brought on myself six or seven years before in Bavaria, by excessive application to public business) and when it is remembered that at the time when I was exposing myself in this manner to the danger of taking cold, I was using the warm bath every day.

But I am firmly persuaded that it was to the *warm bath*, that I was indebted for my escape ; and it is that persuasion which has induced me to publish this account of my experiment.

I am very far indeed from wishing that my example should be followed in all points.—All the unadvised and imprudent details of the experiment may, and ought to be omitted. It would indeed be more than imprudent ; it would be foolish to repeat them. But I do really believe that all those who will be persuaded to adopt the practice of warm bathing, in health and in sickness, will find the greatest and most permanent advantages from it.

Were the general and constant use of the warm bath, by persons in health, a new thing, I should have many scruples in recommending it to the

public, whatever my private opinion of its salubrity might be. But so many nations have practised it for ages ; and there are so many who now practise it, and—what is very remarkable—one (the Russian) which inhabits the coldest parts of the globe, that there cannot possibly be the smallest reason to doubt of its beneficial effects.

With regard to the *pleasant* effects that result from the use of the warm bath, there never has been any difference of opinion. But still, I am quite certain that the true luxury of warm bathing is not understood in this country ; and till the construction of our baths is totally changed, and a different manner of using them adopted, we never can enjoy a warm bath as it ought to be enjoyed.

As we must allow, that in most cases, and particularly in a matter of this kind, it is much more wise and prudent to adopt those arrangements and improvements which have been the result of the experience of ages, than to set down and attempt to invent any thing new ; I think we cannot do better than to rebuild some of the baths which were left us by the Romans. *They* most certainly understood warm bathing, as well as any nation ever did ; and if there be any thing in our climate which renders any deviations necessary from the manner commonly practised in constructing baths in warmer countries, there is no doubt but those luxurious foreigners, who had possession of this island for so many years, must have found them out. The

plans they have left us may therefore be adopted with safety as models for our imitation.

I am far from wishing to see the baths of Dioclesian and Caracalla rise up, in all their splendour, in the neighbourhood of London, for I am well aware that the magnificent and ostentatious exhibitions of a nation of conquerors, and slaves, would but ill accord with the manners of a free, enlightened, and industrious people ; but still I cannot help wishing that the inhabitants of this island, and all mankind, might enjoy all the innocent luxuries and comforts that are within their reach.

I am even jealous of the poor Russian peasant ; and when I see him enjoying the highest degree of delight and satisfaction in the rude cave which he calls a warm bath—without wishing to diminish his pleasure—I greatly lament that so useful and so delightful an enjoyment should be totally unknown to so great a portion of the human species.

Who knows but that the poor Russian, in the midst of his snows—with his warm room, and warm bath—may not on the whole, enjoy quite as much happiness as the inhabitant of any other country ? And if this be really the case, what an addition would it be to the enjoyments of the inhabitants of other, more favoured countries, to add the warm room, and warm bath of the Russian, to all their local advantages ! When I meditate profoundly on these subjects, it is quite impossible for me not to feel my bosom warmed with the most enthusiastic zeal for the diffusion of that know-



ledge which contributes to the comforts and enjoyments of life.

There is nothing more interesting than the results of the ingenuity of man in the infancy of society, before the light of science has extended his views, and increased the number of the objects of his pursuit. Ever intent upon a few simple mechanical contrivances, the usefulness of which he continually experiences, all his thoughts remain concentrated on them, and all his ingenuity and address are employed in rendering them perfect, and using them with agility and effect. When we examine the implements which savage nations have contrived to provide for themselves, almost without tools, we shall see one of the most striking proofs to be found, of the effects of persevering industry, and long experience.

No person of any feeling can contemplate the canoes, snow-shoes, and hunting and fishing-tackle of the North American savages, without experiencing emotions which it would be very difficult to describe: and the ingenuity displayed by the Russian peasant, in the construction and management of his warm bath, is not less striking.

Without any knowledge of the principles of pneumatics, hydrostatics, and chemistry, he has proceeded in the same manner, precisely, as he would have done, had he understood all those sciences; and without money, or the means of purchasing any thing of value, he has contrived,  
with

with the rude materials, of no value, which he finds lying about him, to construct an edifice in which he enjoys, in the most complete manner possible, all the delightful sensations which result from one of the most rational pleasures, of the most refined and luxurious nations. And if security in the possession of an advantage adds value to it, how much greater is the security of the Russian peasant in the enjoyment of his luxuries, than the rich and effeminate in the possession of theirs?—Nothing is more calculated to fill us with wonder and admiration than to see how the different situations of man, on this globe, have been equalized by compensations!

The warm baths of the Russian peasants have so often been described, that I dare not take up the reader's time unnecessarily by given a particular account of them. They are, as is well known, what are called vapour baths; and as those who build them are much too poor to afford the expence either of boilers, or bathing tubs, they are heated in a manner which is equally ingenious and economical. A parcel of stones are heated upon a wood fire made on the ground, and when these stones are hot, water or snow is thrown on them, and the steam which is produced, rises up and occupies the inside of the arched roof of the cave which constitutes the bath.

Those who enjoy the bath, place themselves, extended at full length, on a bed composed of the small twigs and leaves of trees, on hurdles in the

form of shelves, placed round the cave, under its vaulted roof, and above the level of the top of the door way.

From this short description it is evident, that the air occupying the top of the cave, and which is heated by the steam, being rendered specifically lighter than the cold air without, by the heat it has acquired, will remain in its place, even though the entrance into the cave should not be provided with a door. A few branches of trees placed against the door-way would break the force of the wind, if any were stirring, and the bath would remain as warm as should be required, for any length of time, even in the most severe frost of a Russian winter, with the expence of a very small quantity of fuel.

Were I asked to give a plan for a warm bath, by a friend who had full confidence in my abilities to execute such an undertaking with intelligence, I should adopt, with little deviation, all the principles of the Russian baths.

The bath room should be built of bricks; and should be covered above by a gothic or pointed dome; and the entrance into it should not be through the side walls, but through the pavement, by a flight of steps from below. The walls should be double, the inner wall being made as thin as possible, and the room should be lighted by three or four very small double windows of single panes of glass situated just below the spring  
of

of the dome, which might be at the height of seven or eight feet above the pavement.

As the (double) walls of the building would be of some considerable thickness, and as the windows ought to be small, and double, it would be very easy to construct them in such a manner that a person from without should not be able to see any person in the bath, even though they were to get a ladder, and attempt to look in at the window. One of the windows should be made to open, in order to ventilate the bath.

The inside of the walls, and dome of the bath room should be plaistered, and afterward well painted in oil;—or, (what would have a neater and more elegant appearance), they might be lined with Dutch tile.

The pavement might be made of any kind of flat stones, or of bricks, or tiles; or it might be constructed of stucco, well painted in oil, and it might be covered with matting.

If ornament were required, I would place a figure of Vesta, holding an Argand's lamp, on a pedestal, on one side of the room. This pedestal, which should be large in proportion to the figure, should be made of sheet copper, and painted of a bronze colour on the outside. The cavity within it should be accurately closed on every side, in order that it might occasionally be filled with steam from a boiler situated without, and used as a stove for warming the room.

The important object had in view in making the entrance into this bath from below (the preservation of the warm air in the room) might be attained equally well with the door placed on one side of the room, provided the door were made to open immediately into a narrow descending vaulted gallery, furnished with a good door at the lower end of it.

The top of the door at the lower end of this gallery should be two or three feet below the level of the bottom of the door at the top of it, which opens into the bath.

By setting both these doors open; and at the same time opening one of the windows of the bath, all the warm air in it, below the level of the window, will be forced out, in a very few moments, and the room will be completely ventilated.

If the entrance be made through the side of the room, in the manner just described, this will render the form of the room more simple, and more elegant, than if the passage into it were from below, through the pavement,

If the pavement of the bath be on a level, or nearly on a level, with the surface of the ground, the entrance into it must, nevertheless, come from a lower place. If the door leading into the bath be situated at one side of the room, the vaulted gallery, with which it communicates, must descend below the level of the surface of the ground, and a passage must be opened from without, in  
order



order to arrive at the door which must close this gallery at its lower extremity.

A steam boiler should be placed under the bath, in a vaulted room, and the smoke from the closed fire-place of the boiler should be made to circulate in flues under the pavement of the bath, near the walls of the room, in which part the pavement should not be covered with matting.

A bathing tub should stand on one side of the room, and opposite to it should be placed a bamboo or caned sofa, covered, first with a soft thick blanket, and then with a clean sheet, thrown over it.

The bathing tub, which might be of the usual dimensions, should be placed on a platform of wood, covered with sheet lead, about seven or eight feet square, and raised six or seven inches above the pavement. This platform should be flat, and nearly horizontal, with a border all round it, about two or three inches high, and a leaden pipe at the lowest part of it, to carry off the water that happens to fall on it.

The lead should be covered by thin boards, or by a loose piece of matting; and a caned chair, or a stool, should be placed on the platform, by the side of the bathing tub. A pipe should be prepared for admitting cold water into the bathing tub from a reservoir situated without the bath; and another for bringing steam into it, to heat it, from the steam boiler. There should likewise be a waste

waste pipe for carrying off the water when the bathing tub is emptied.

The bathing tub should not be set down immediately upon the lead which covers the platform on which the tub is placed, but should be raised eight or ten inches above it, in order that the air may pass freely under the bottom of the tub; and that there may be room to come at the lead, to wash it, and clean it, in every part.

A bath constructed in the manner here described might be kept constantly warm, all the year round, at a very small expence for fuel; and in that case, it would always be ready for use.

It is equally well calculated to serve as a warm air-bath;—as a vapour-bath;—or as a warm water-bath;—and when it is used as a water-bath, the air in the room may be made either warm, or temperate, at pleasure.

This last circumstance I take to be a matter of the greatest importance; for nothing surely can be more disagreeable than the sensations of a person on getting out of a tub of warm water, and standing shivering with cold, till he is wiped dry, and dressed; and I cannot help suspecting, that such a situation is as dangerous as it is unpleasant.

I am much inclined to think that the warm *air-bath*, with occasional washing with warm water, will be found to be not only the most pleasant, but also the most wholesome of any; and if that should be the case, no building could answer for  
that

that purpose in this country—(where the temperature of the atmosphere is always so much below that which would be wanted) unless it were constructed on principles similar to those, on which the plan above described is founded.

*Hot air* may at any time be procured in any climate, but a large mass of air moderately and *equally* warm cannot be *preserved* in a cold country, by any other means than by preventing its being cooled, and preventing its being driven away by the denser surrounding medium.

The double walls, and small double windows of the bath, which I have recommended, will prevent the *cooling* of the air in it; and the form of the room renders it absolutely impossible for the cold air of the atmosphere, either to mix with that warm air, or to *force it out of its place*.

If it be required to mix steam with the air of the room to render it moist, that may be done by laying a steam tube for that purpose from the boiler, into the room; or it may be done in a manner still more refined and luxurious, by having a small portable boiler for that purpose, heated by a spirit lamp, or a common tea urn, heated, or rather kept boiling, by an iron heater; or a common tea-kettle heated by a spirit lamp, might be made use of. The water might be brought in, already boiling hot, and if a quantity of cloves, or other spices were mixed with it, the room would be filled with the most grateful, and most salutary perfumes. By burning sweet scented woods or  
aromatic

aromatic gums and resins in the room, in a small chafing dish filled with live coals, the air in the room would be perfumed with the most pleasant aromatic odours.

Those who are disposed to smile at this display of eastern luxury, would do well to reflect on the sums they expend on what *they* consider as luxuries; and then compare the real and *harmless* enjoyments derived from them, with the rational and innocent pleasures here recommended. I would ask them, if a statesman, or a soldier, going from the refreshing enjoyment of a bath such as I have described, to the senate or to the field, would, in their opinion, be less likely to do his duty, than a person whose head is filled, and whose faculties are deranged, by the fumes of wine.

*Effeminacy* is no doubt very despicable, especially in a person who aspires to the character and virtues of a man; but I see no cause for calling any thing *effeminate*, which has no tendency to diminish either the strength of the body;—the dignity of sentiment;—or the energy of the mind. I see no good reason for considering those grateful aromatic perfumes, which in all ages have been held in such high estimation, as a less elegant, or less rational luxury than smoking tobacco; or stuffing the nose with snuff.

Having given a slight sketch of a bath on a scale of magnificence and refinement, which will not suit every person's circumstance; and may not accord with every person's taste, I will now give

another on a less expensive, and more modest plan.

Let a small building be erected, 14 feet 5 inches long, and 9 feet wide, measured within, and 7 feet high; and let it be divided into equal rooms of 9 feet long, and 7 feet wide each, by a partition wall of brick  $4\frac{1}{2}$  wide, or equal in thickness to the width of a brick. Let the outside walls of this little edifice be double, the two walls being each the width of brick in thickness, and the void space between them, being likewise of the same thickness, viz. about  $4\frac{1}{2}$  inches. In order to strengthen these double walls, they may be braced and supported one against the other, by uniting them, in different parts, by single bricks, laid across, with their two ends fixed in the two walls.

Instead of a floor of boards, these two little rooms should be paved with 12 inch tiles, or flat stones, laid in such a manner, on thin parallel walls, ( $4\frac{1}{2}$  inches in thickness) as to form horizontal flues under every part of the pavement.

There should be no door of communication between these rooms, but each should have its separate entrance from without, by a door opening directly into a separate narrow descending covered gallery. These two doors should be placed on the same side of the building, and their two separate descending galleries may be parallel to each other, and may indeed be covered by the same roof.

They may together, form one gallery, divided  
into



into two narrow passages by a thin partition wall, constructed with bricks.

A small porch at the bottom of the gallery should be common to both passages, but each passage should, nevertheless, have its separate door, at its lower extremity, where it communicates with the porch.

The top of the door-way of this descending passage, at its lower extremity, must be at least one foot below the level of the pavement of the rooms.

This passage may be furnished with a flight of steps; or its descent may be made so easy as to render steps unnecessary.

If there should be no natural elevation of ground at hand, on which this bath can conveniently be situated, a mound of earth must be raised for that purpose; otherwise it will be necessary that the porch at the end of the gallery should be situated 7 or 8 feet below the surface of the ground; for it is indispensably necessary that the entrance into the bath should be by an *ascent*, and in a *covered gallery*.\*

The building may be covered with a thick thatched roof, which will, on some accounts, be better than any other; but any other kind of roof will answer very well, provided it be tight; and that a quantity of straw, or of chaff, or of dry leaves

\* If the entrance into the houses of poor cottagers were constructed on the same principles, this simple contrivance would save them more than half their expences for fuel, in cold weather.

leaves be laid over the ceiling of the two small rooms, under the roof, to confine the heat. The ceiling of the rooms should be lathed and plaistered, and the walls of the room should be plaistered and white-washed.

At the end of one of the rooms opposite to the door, a bathing tub should be placed; and in the other a caned sofa.

The bathing tub should be placed on a platform 7 feet square, covered with sheet lead, and raised about nine inches above the level of the pavement. This platform should have a rim all round it, and a pipe for carrying off out of the room, the water that accidentally falls on it.

The bathing tub should be supplied with cold water from a reservoir (a common cask will answer perfectly well for that use) which should stand without the house.

The water should be admitted cold into the bathing tub, and should be warmed in it, by means of steam, which may come from a small steam-boiler, which should be situated without the building, and near to the reservoir of cold water. A small open shed, made against one side of the building—that side of it which is opposite to the entrance gallery—may cover both the boiler and the reservoir. The boiler, which need not be made to contain more than six or eight gallons, should be well set in brick-work, and well covered over with bricks, to prevent the loss of heat which would result from any part of the boiler

boiler being exposed naked to the cold air of the atmosphere.

This boiler should be so fitted up, by means of a ball-cock, as to feed itself regularly with water from the neighbouring reservoir.

The boiler should be furnished with a safety valve, opening into the open air, and with a tube for conveying steam into the bathing-tub. This tube, which may be a common leaden pipe, about half an inch in diameter, should be wound round with the lift of coarse cloth, or with any warm covering of that sort, to confine the heat.

This steam tube should rise up perpendicularly from the boiler to the height of eight or ten inches above the level of the ceiling of the bath-room, and should then be bent towards the building, and made to enter the roof of it, and then to descend perpendicularly through the ceiling of the bath-room, and enter the bathing-tub. Its open end should reach to within an inch of the bottom of the tub, and a little above the level of the top of the tub there should be a steam-cock, by means of which the passage of the steam through the steam-tube, and into the water in the bathing-tub, may be regulated, or prevented entirely, as the occasion may require.

There may be a short branch, six or eight inches long, inserted into the steam-tube just described, which branch will serve for admitting steam into the room when it is designed to be used as a steam, or vapour-bath.—This short  
branch

branch must of course be furnished with its own separate steam-cock.

The smoke from the (closed) fire-place of the boiler must be made to circulate under the pavement of the two rooms of the bath, in the flues constructed for that purpose, before it is suffered to pass off into the chimney.

The chimney should stand on the outside of the building, and be made to lean against, and be supported by the wall of the building. There should be a damper in this chimney.

Each of the small rooms should be furnished with a small double window; each window consisting of one large pane of glass, and being made to open by means of a hinge, placed on one side of it.

These windows should be placed as near the ceiling of the room as possible, in order to facilitate the perfect and speedy ventilation of the bath. The inside windows may be placed level with the inside of the wall of the house; and the outside window level, or flush, with the outside wall. Either the inside windows or the outside windows should be made of ground or of wavy glass, in order that a person in the bath may not be exposed to being seen through the windows.

The two small rooms may be distinguished by calling one of them the *bath-room*, and the other the  *dressing-room*.

If it be required to heat the two rooms in a very short time, the one with vapour, and the

other with dry air, equally warmed, and perfectly free from all disagreeable smells, this may be done by the following simple contrivance. Let a cylinder of very thin copper, about eight inches in diameter, and five feet in length, be placed horizontally under the sofa in the dressing-room, and let a steam-pipe from the boiler be laid into it, with another pipe for carrying off the water resulting from the condensation of the steam in it. By admitting steam into this tube, the air in the room will soon be warmed, without any watery vapour being mixed with it;—and by admitting steam into the bath-room, and allowing it to mix with the air of that room, a vapour-bath will be formed, and in a very few minutes will be ready for use.

A small quantity of cold water may then be admitted into the bathing-tub, and the steam being turned into it, it will soon be made warm enough to be used for washing, after the steam-bath has been used.

The passage from the bath-room into the dressing-room will be attended with no danger from cold; and it will be found very pleasant to dress and repose in a warm room, where the air is pure, and not charged with vapour, after coming out of the water, or out of a vapour-bath.

If there should be any apprehension that either the bath-room, or the dressing-room, might be too much heated by the smoke from the boiler passing continually through the flues under the pavement,



pavement, a canal, furnished with a damper, leading from the closed fire-place of the boiler immediately into the chimney, might be made; and whenever the pavement should become too hot, by opening this canal the smoke would pass off immediately into the chimney by the shortest road, and the pavement would receive no more heat from it. I think it would in all cases be advisable to take this precaution, in constructing a bath on the principles here recommended.

But I must hasten to finish this long dissertation; and I shall conclude it with a few passages from a modern traveller (M. SAVARY) who may be considered as being well qualified to give an opinion on the subject in question.

Speaking of the manner of using the warm bath in Egypt, he says, “The bathers here are not  
 “imprisoned, as they are in Europe, in a kind of  
 “tub, where one is never at one’s ease. Extended  
 “on a cloth spread out, with the head supported  
 “by a small cushion, they can stretch themselves  
 “freely in every posture, whilst they lie quite at  
 “their ease, enveloped in a cloud of odoriferous  
 “vapours, which penetrates all their pores. In  
 “this situation they repose for some time, till a  
 “gentle moisture upon the skin appears, and by  
 “degrees diffuses itself over the whole body. A  
 “servant then comes and *masses* them (as it is  
 “called, from a word in the Arabic language,  
 “which signifies *to touch in a delicate manner.*) He

“ seems to knead the flesh, but without causing  
“ the smallest pain; and when that operation is  
“ ended, he puts on a glove, made of woollen stuff,  
“ and rubs the skin for a considerable time.

“ During the whole of this time the sweat continues to be most profuse; and a considerable  
“ quantity of scaly matter, and other impurities,  
“ which obstructed the pores of the skin, are removed, and the skin becomes quite soft, and as  
“ smooth as satin.

“ When this operation is ended, the bather is  
“ conducted into a closet, in which there is a cistern, supplied with hot, and with cold water,  
“ which comes into it through two separate pipes,  
“ each furnished with a brass cock. Here a lather  
“ of perfumed soap is poured over him.

“ After being well washed and wiped, a warm  
“ sheet is wrapped round him, and he follows the  
“ attendant through a long winding passage into  
“ an external and more spacious apartment. This  
“ transition from heat to cold produces no disagreeable sensations, nor any bad consequences.

“ In this airy apartment a bed of repose is found  
“ prepared, and fresh and dry linen is brought.  
“ A pipe is also brought, and coffee is served.

“ Coming out of a hot bath, where one was  
“ surrounded by a cloud of warm vapours till the  
“ sweat gushed from every pore, and being transported into the free air of a spacious apartment,  
“ the breast dilates, and one breathes with voluptuousness. The pores of the body being perfectly

“fectly cleaned, and all obstructions removed, one  
“feels as it were regenerated; and one experiences  
“an universal comfort. The blood circulates with  
“freedom, and one feels as if disengaged from an  
“enormous weight, with a sense of suppleness and  
“lightness, which is as new as it is delightful. A  
“lively sentiment of existence diffuses itself over  
“the whole frame, and the soul, sympathizing in  
“these delicate sensations, enjoys the most agree-  
“able ideas. The imagination, wandering over the  
“universe, which it embellishes, sees on every side  
“the most enchanting pictures—every where the  
“image of happiness!

“If the succession of our ideas be the real mea-  
“sure of life, the rapidity with which they then  
“recur to the memory, and the vigour with which  
“the mind runs over the extended chain of them,  
“would induce a belief, that in the two hours of  
“delicious calm that succeeds the bath, one has  
“lived a number of years!”

END OF THE THIRTEENTH ESSAY.

THE HISTORY OF THE  
CITY OF LONDON  
FROM THE FOUNDATION  
TO THE PRESENT  
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# ESSAY XIV.

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*SUPPLEMENTARY OBSERVATIONS*

RELATING TO

THE MANAGEMENT

OF

FIRES IN CLOSED FIRE-PLACES.



## CONTENTS OF THIS ESSAY.

*Necessity of keeping the doors of closed Fire-places well closed; and of regulating the air that is admitted into them.—Account of some experiments, which shewed, in a striking manner, the very great importance of those precautions.—A method is proposed for preventing the passage of cold air into the large fire-places of Brewhouse Boilers, Distillers Coppers, Steam-Engine Boilers, &c. while they are feeding with coals.—Bad consequences which result from overloading closed Fire-places with fuel.—Computations, which shew, in a striking manner, the vast advantages that that will be derived from the use of proper care and attention in the management of fire, and in the direction and economy of the heat which results from the combustion of fuel.*

## ESSAY XIV.

*Of the Management of Fires in closed Fire-places.*

**T**HOUGH I have already mentioned, more than once, the necessity of preventing the entrance of air into a closed fire-place, by any other passage than by the register of the ash-pit door, and have strongly recommended the keeping of the door of the fire-place constantly closed; yet, as I have since found that those precautions are even of more importance than I had imagined, I conceived that it might be useful to mention the subject again, and give an account of the series of experiments, from the results of which I have acquired new light in respect to it.

In fitting up a large shallow circular kitchen boiler (one of those I put up in the kitchen of the house formerly occupied by the Board of Agriculture) I made an experiment, which, though it appeared to me at the time to have succeeded perfectly, led me into an error, that afterwards caused me a great deal of embarrassment. I constructed the fire-place of the boiler, of a peculiar form, for the express purpose of *burning the smoke*; imagining, that if I could succeed in that attempt, I should not only get more heat from any given quantity of coals, but also, that the narrow horizontal canal that carried off the smoke from the fire-place to the chimney, would be much less liable to be  
choaked

choaked up by soot or dust. The fire-place was made rather longer than usual; and near the farther end of it there was a thin piece of fire-stone, placed edge-wise, which run quite across it, from side to side, a space being left about  $2\frac{1}{2}$  inches wide, between the lower edge of this stone and the bars of the grate, while the bottom of the boiler reposed on its upper edge.

From this description it is evident, that the flame of the burning fuel, after rising up and striking against that part of the bottom of the boiler which was situated over the hither part of the fire-place, must necessarily pass under the lower edge of the stone just mentioned, in order to get into the canal leading to the chimney; and I fancied, that by taking care to keep that *narrow passage* constantly occupied by red-hot coals, the smoke, being forced to pass through between them, would necessarily take fire, and burn. This actually happened; and when I left a small opening in the door of the fire-place, to give admittance to a little fresh air to facilitate and excite the combustion, the flame became so exceedingly vivid and clear, that I promised myself great advantages from this new arrangement.

Being soon after engaged in putting up a large square boiler in the kitchen of the Foundling Hospital, I there introduced the same contrivance;—but how great was my surprize on finding, that notwithstanding the extreme vivacity of the fire, the contents of the boiler could not be brought to boil in less time than five hours! The fire-place,

it

it is true, was small, and the brick-work was new and wet; but I found that the quantity of coals consumed was such, that had there been no essential fault in the construction of the fire-place, nor in the management of the fire, the contents of the boiler ought, notwithstanding these unfavourable circumstances, to have boiled in less than one-third part of the time that had been found necessary to bring it into a state of ebullition.

Having wasted two or three days in attempting to remedy the defects of this fire-place, without changing entirely the principles of its construction;—concealing my disappointment from those who it was necessary should have confidence in my skill, by representing to them all that had been done as being a mere experiment, I pulled down the work to the foundation, and caused it to be rebuilt on principles which I knew could not fail to succeed, and which did succeed to the utmost of my expectations.

Though I ruminated often on this disappointment, I did not find out the real cause of my ill success for some months. This discovery was, however, at length made, and in such a manner as to leave no room for doubt.

Having, as an experiment, constructed in the kitchen of the Military Academy at Munich, an apparatus for the performance of all the different processes of cookery, and to serve occasionally for warming a room, with one and the same fire, thinking that the principles of the invention might be employed with advantage in the construction of  
cottage

cottage fire-places, on my return to this country I made the experiment at my lodgings in Brompton-row, Knightsbridge; and, desirous of accommodating the contrivance to what I think may be called a prejudice of Englishmen, I contrived the machinery in such a manner as to render the fire *visible*.

A small low grate was fixed in the middle of a large open kitchen fire-place, and on each side of it were fixed in brick-work two Dutch ovens, one above the other; the bottom of the lower oven, on each side, being nearly on a level with the top of the grate; and as each of the ovens was surrounded by flues, I had hopes, that by causing the flame and smoke of the open fire to incline downwards, and enter an horizontal canal, situated just behind the fire, and there to separate to the right and left, and circulate under the iron bottoms of the ovens, they would, by that means, be sufficiently heated to bake or to boil; and even if the two upper ovens should not be found to be sufficiently heated to perform those processes of cookery, I thought, by leaving their doors open, they might at least be very useful, occasionally, for warming the room, acting in the manner of a German stove: but the experiment was far from succeeding as I expected.

The current of flame and smoke which arose from the open fire, was, without difficulty, made to bend its course downwards into the canal destined to receive it, and to circulate in the flues of the ovens; but, to my astonishment, I found that the ovens, instead of being heated, were barely warmed: an



accident, however, very fortunately for me, discovered to me the real cause of the ill success of the experiment.—Throwing a piece of paper on the top of the coals that were burning in the grate, in order to see if *the whole* of the large flame which I knew the paper must produce, would be drawn downwards into the horizontal opening of the canal, situated behind the back of the grate, I was surprized to find that this flame was not only drawn into this opening, but that it appeared to be violently *driven downwards*, to the very bottom of the canal.

In short, every appearance indicated that there was a very strong vertical *wind* that was continually blowing *directly downwards* into the opening of the canal: and it immediately occurred to me, that as this wind consisted of a stream of cold air, this air must necessarily cool the ovens almost as fast as the flame heated them; and I was no longer surprized at the ill success of my experiment.

On considering the subject with attention, I saw how impossible it must be for the current of hot vapour, flame, and smoke, that rises from burning fuel, to be made to pass off *horizontally*, or to deflect considerably from its direct ascension, *in contact with the cold air of the atmosphere*, without drawing after it a great deal of that cold air: and I now saw plainly why so much time and fuel were required to heat the boiler in the kitchen of the Foundling Hospital, in the experiments that were made with its first fire-place.

The cold air which entered the fire-place at its  
door,

door, and passing *over* the surface of the burning fuel, entered the flues of the boiler with the flame, cooled the bottom of the boiler almost as fast as the flame heated it.

The waste of heat that is occasioned *precisely in this manner* in the fire-places of steam-engines, brewers coppers, distillers coppers, &c. must be very great indeed. To be convinced of this fact, nothing more is necessary than to see how very imperfectly the entrance into one of these fire-places is closed by its single door, ill fitted to its frame—what a length of time the door is left *wide open* while the fire is stirring, or fresh coals are putting into the fire-place—and what an impetuous torrent of cold air rushes into the fire-place on those occasions.

As the cold air that comes into the fire-place in this manner, and passes *over* the burning coals, has very little to do in promoting the combustion of the fuel, and must necessarily be heated very hot in passing through the fire-place, and through the whole length of the flues of the boiler, it is easy to see what an immense quantity of heat this air must steal, and carry off into the atmosphere in its escape up the chimney.

To remedy this evil, the doors of all closed fire-places should be double, and they should be fitted to their frames with the greatest nicety, which may easily be done by making them shut against the front edge of their frames, instead of being fitted *into them*, or into grooves made to receive them; and when the fire is burning, these doors  
M should

should be opened as seldom as possible, and for as short a time as possible. I have already mentioned the necessity of these precautions in my sixth Essay, but they are of so much importance that they can hardly be too often recommended, nor can too much pains be taken to shew why they are so necessary.

In all cases where a fire-place is very large, and where, in consequence of the large quantity of coals consumed in it, the fire-place door is necessarily kept open a great deal, I would earnestly recommend the adoption of a contrivance, which I think could not fail to turn out a complete remedy for the evil we have been describing—viz. the entrance of a torrent of cold air into the fire-place through its door-way.

The contrivance is this—to construct the floor or pavement of the area before the fire-place door in such a manner as to cut off all direct communication, without the fire-place, in front of it; between the ash-pit and the fire-place door-way; and when this is done, to build a porch, well closed above, and on every side, immediately before the fire-place door, and in such a manner that the fire-place door may open into it.

This porch must have a door belonging to it, situated on the side opposite to the fire-place door, which door (that belonging to the porch) must open outwards, and must fit its door-frame with considerable nicety. There must also be a glass window, either in this door, or over it, or on one side of it, or in one of the side walls of the porch; and

and there must be sufficient room in the porch to allow of a certain provision of coals being lodged there, and kept ready for use.

When fresh coals are to be thrown into the fire-place, (as also when the door of the fire-place is to be opened for the purpose of stirring the fire, or for any other purpose) the person who is charged with the care of the fire enters the porch, and then, carefully shutting the door of the porch after him, he opens the fire-place door.

As no air can get into the porch from without, its door being closed, none can pass through it into the fire-place, and the fire-place door may be left open without the smallest inconvenience; and the person who tends the fire may take up as much time as he pleases in stirring it, or feeding it with fresh fuel, for little or no derangement of the fire, or loss of heat, will result from these operations. The fire will continue to burn nearly in the same manner as it did before the fire-place door was opened; and those immense clouds of dense smoke, which, to the annoyance of the whole neighbourhood, are now thrown out of the chimnies of all great breweries, distilleries, steam-engines, &c. as often as they are fed with fresh coals, will no longer make their appearance.

When these operations are finished, and the fire-place door is again closed, the door of the porch may be opened, and the provision of coals kept in the porch for immediate use may be again completed.

If the flame from the fire-place should be found to have any tendency to come into the porch, this  
may

may be easily checked, by leaving a very small hole in the door of the porch for the admission of a small quantity of air, just enough to prevent this accident. This small hole might be furnished with a register.

But it is not merely through the opening by which the fuel is introduced, that cold air furtively finds its way into closed fire-places : it frequently enters in much too large quantities by the ash-pit door-way, and rushing up between the bars of the grate, and mixing with the flame, serves to diminish instead of increasing the heat applied to the bottom of the boiler ; and this never fails to happen when a *small fire is made in a large fire-place* ; or when a part of the grate happens not to be covered with burning fuel, especially when there is no register to the ash-pit door.

It should be remembered, that whenever more air enters a closed fire-place than is actually *decomposed* by the burning fuel, all that super-abundant air, not only is of no service whatever, but being itself heated at the expence of the fire, and going off hot by the chimney ; occasions the loss of a quantity of heat that might have been usefully employed.

Ash-pit doors should always be furnished with registers, of whatever size the fire-place may be, for they are always indispensably necessary to the good management of a fire ;—and where small fires are occasionally made in large closed fire-places, the ascent of air through that part of the grate that is not covered with burning fuel should



be prevented, by sliding an iron-plate under the bars of the grate, or by some other contrivance equally effectual.

If the closed fire-places of boilers, great and small, were properly constructed, and if due care were taken to introduce in a proper manner, and to regulate the quantity of the air that is necessary to the perfect combustion of the fuel, their grates might be made considerably narrower than they now are, and the bottoms of their boilers might be placed at a greater height above them; from which arrangement several advantages would be derived: but as long as so little care is taken to keep the door of the fire-place well closed, and to prevent too much air from coming up through the grate, by the openings between its bars, the bottom of the boiler must be placed very near the surface of the burning coals, otherwise so much more cold air than is wanted will find its way into the fire-place, and mix with the flame, that the bottom of the boiler cannot fail to be sensibly cooled by it.

When a boiler is properly set, if a fire, of a moderate size, that burns well, does not heat it in a reasonable time, the fault must necessarily lie in the bad management of the doors and registers of the fire-place: for as the heat required to heat the boiler is *a certain quantity*, which cannot vary, if the boiler is not found to be heated as fast as it ought to be, by the quantity of fuel consumed, a part of the heat generated must necessarily go to heat something else; and there is nothing at hand that  
can

can take it, except it be the cold air of the atmosphere ; which, whenever it is permitted to enter a fire-place in an improper manner, or in too large quantities, never fails to rob it of a great deal of heat, which it takes with it up the chimney, as has already been observed.

If the door by which the fuel is introduced into the closed fire-place of a kitchen boiler is not kept constantly closed, it is quite impossible that a well-constructed fire-place can answer.—With such neglectful management *a bad fire-place* is certainly *preferable* to a good one ; for when an enormous quantity of fuel is consumed under a boiler, some part of it must necessarily find its way into it, even if, instead of being set in brick-work, it were suspended over the fire, in the open air ; but when a fire-place is made no larger than is necessary in order to heat the boiler in a proper time, when the door of the fire-place is kept closed, it is not surprising that the boiler should be much slower in acquiring heat, when a stream of cold air is permitted to strike against its bottom, and blow all the flame and hot smoke out of its flues into the chimney.

It would be just as unreasonable to object to the fire-places I have recommended on account of the *trouble of keeping them closed*, as it would be to object to a scheme for warming a dwelling-house merely because it required that the street-door should not be left open.—The cases are exactly similar ; and if insisting on the attention of servants in the one case is not unreasonable ; it cannot be so in the other.

There was a time, no doubt, (when the doors of rooms first came in fashion) that the trouble they occasioned to servants was considered as an hardship, and severity in exacting attention to the proper management of them as a grievance ; but all improvements are progressive, and we may hope that a time will come when it will be considered as careless and slovenly to leave open the door of a closed fire-place. In the mean time it is my duty to declare, in the *most serious and public manner*, that those who have not influence enough with their servants to secure due attention being paid to this important point, would do wisely not to attempt to introduce the improvements in closed fire-places which I have recommended. And it is not sufficient merely to be attentive to the shutting of the fire-place door ; care must be taken also to manage properly the register of the ash-pit door, otherwise, if it be left too much opened, a great deal too much cold air will find its way into the fire-place between the bars of the grate.

When a closed fire-place is properly constructed, it is hardly to be believed how small a passage is sufficient to admit as much air as is necessary or useful to maintain the combustion of the fuel.

A fault, which is often committed in the management of the closed fire-places I have recommended, is the *over-loading them with fuel*. This mistake has several bad consequences, and among them there is one which would not naturally be expected ; it prolongs the kindling of the fire, and  
very

very frequently so much so as to prolong the heating of the boiler, notwithstanding the fierceness of the fire when the fuel is all inflamed.

Great care should at all times be taken not to overcharge a fire-place with fuel, but more especially when the fire is first kindled, and the fire-place, and every thing about it, is cold. It should be remembered that a great deal of heat is necessary to warm the fuel itself, and bring it to that degree of heat which it must have in order to its being capable of taking fire; and as long as there remains any cold fuel in the fire-place to be heated, very little heat will reach the bottom of the boiler.

All the money that is expended in the purchase of wood to kindle coal fires, is money well laid out; and it is by no means good economy to be sparing of wood in kindling such fires. In many cases it would, I am convinced, be cheaper to burn wood than coals, even in London, especially in the closed fire-places of small kitchen boilers and stewpans, where a fire is wanted but for a short time. This proposal to burn wood instead of coals, or charcoal, has already been made more than once; and the more I have considered the subject, the more I am convinced that the former would turn out to be the cheapest fuel.

A great deal of fuel is consumed in this country for boiling water to make tea. I was curious to know how low it would be possible to reduce that

expencc, and ascertained that point by the following experiments and computations :

I supposed a small family, consisting of two persons, to drink tea twice every day (morning and evening) during one whole year, and that 2 pints of water, at the temperature of  $55^{\circ}$  (the mean annual temperature of the atmosphere in Great Britain) was heated, and made to boil every time tea was made.

I found on enquiry that the most costly firewood that is sold in London, dry beech in billets, at the highest price it is ever sold at, cost one farthing per lb. avoirdupois weight ; that is, at the rate of *two-pence* per billet, weighing, at an average 8lbs. By wholesale these billets are sold in London at *one-penny-half-penny* each.

I had some of these billets sawed into lengths of about 5 inches, and then split into small pieces (about the size of the end of one's little finger) and bound up with a packthread into little small bundles, weighing about 4 or 5 ounces each. In the middle of each bundle there were a few smaller splinters, and a very small piece of paper, that the bundle might easily be set on fire with a candle, or with a common match.

On using the small portable furnace represented in the figure 63, and described in chap. XI. of the Tenth Essay, page 293, and the small tin tea-kettles represented in the figure 68, in that Essay, I found, by an experiment, which was repeated several times, that I could boil 2 pints  
of



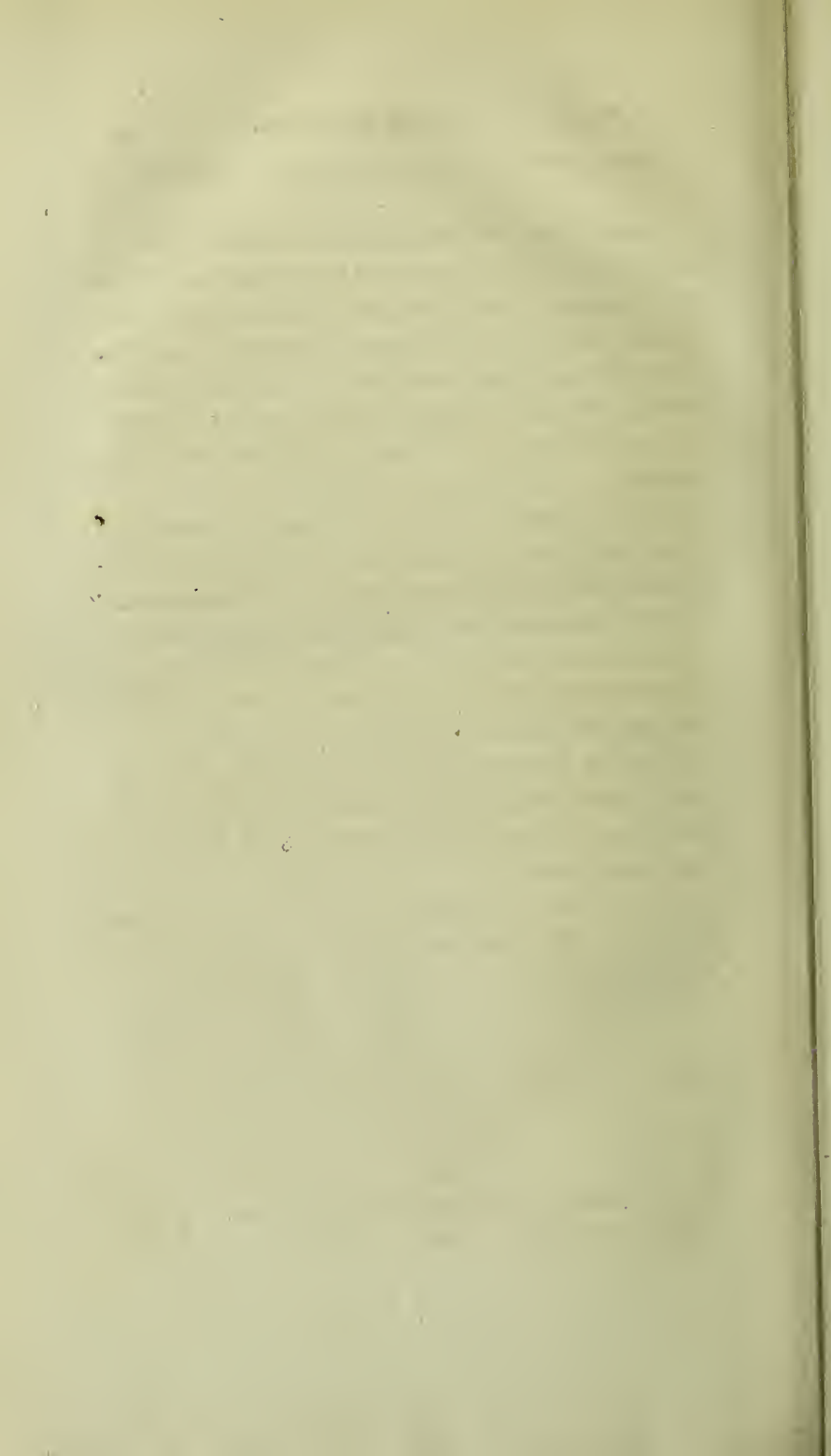
of water with a bundle of wood, weighing 4 ounces.

Hence it appears that the daily consumption of wood in boiling water for tea for two persons would be 8 ounces, or half a pound weight ; consequently for one year, or 365 days,  $182\frac{1}{2}$  lbs. would be required ; and that quantity, at 1 farthing the pound, would cost  $182\frac{1}{2}$  farthings =  $45\frac{5}{8}$  pence, or *three shillings and nine-pence-halfpenny and half a farthing.*

Were it possible to heat so small a quantity of water, with the consumption of the same proportion of fire-wood, as was found to be sufficient for heating water in some of the experiments, of which an account is given in the Sixth Essay, the annual expence for fire-wood for boiling water for making tea for two persons twice a day, would amount to no more than 57 lbs. weight, which, at the London price of this wood, one farthing in the pound, would cost 57 farthings, or *one shilling and two-pence-farthing.*

It is by computations of this sort, founded on the results of unexceptionable experiments, that we are enabled to appreciate the vast saving to individuals, and to the public, that would result from proper attention being paid to the management of fire, and to the economy of heat.

END OF THE FOURTEENTH ESSAY.



ESSAY XV.

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OF THE USE OF STEAM,

AS A

VEHICLE FOR TRANSPORTING HEAT

FROM

ONE PLACE TO ANOTHER.

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*Many unsuccessful attempts have been made, at different times, to heat liquids by means of steam—Reason why these attempts failed—When steam is used for heating a liquid, it must be introduced into it far below its surface, otherwise, as heat does not descend in fluids, the liquid cannot be uniformly heated—Detailed account of an apparatus, by means of which liquid may be heated, and made to boil, by steam coming from a boiler at a distance, and introduced into them—This plan has been adopted with the most complete success—Description of the DYEING-HOUSE of Messrs. Gott and Co. at Leeds, in which all the Coppers are heated by steam—Description of the CULINARY STEAM APPARATUS in the kitchen at the house of the Royal Institution—Proposals for employing hot, or strong steam, in ALLUM WORKS, and in DISTILLERIES—Of the use that may be made of steam in DRYING-HOUSES.*

## E S S A Y XV.

*Of the Use of Steam, as a Vehicle for transporting Heat.*

MANY attempts have been made, at different periods, to heat liquids by means of steam introduced into them; but most of these have failed: and, indeed, until it was known that fluids are non-conductors of heat, and, consequently, that heat cannot be made to *descend* in them—(which is a recent discovery)—these attempts could hardly succeed; for, in order to their being successful, it is absolutely necessary that the tube, which conveys the hot steam, should open into the *lowest part* of the vessel which contains the liquid to be heated, or nearly on a level with its bottom; but as long as the erroneous opinion obtained, that heat could pass in fluids *in all directions*, there did not appear to be any reason for placing the opening of the steam tube *at the bottom of the vessel*, while many were at hand which pointed out other places as being more convenient for it.

But to succeed in heating liquids by steam, it is necessary, not only that the steam should enter the liquid at the bottom of the vessel which contains it, but also that it should enter it *coming from above*.

The



The steam-tube should be in a vertical position, and the steam should *descend* through it, previous to its entering the vessel, and mixing with the liquid which it is to heat; otherwise this liquid will be in danger of being forced back by this opening into the steam-boiler; for as the hot steam is suddenly condensed on coming into contact with the cold liquid, a vacuum is necessarily formed in the end of the tube; into which vacuum the liquid in the vessel—pressed by the whole weight of the incumbent atmosphere—will rush with great force, and with a loud noise; but if this tube be placed in a vertical position, and if it be made to rise to the height of six or seven feet above the level of the surface of the liquid which is to be heated, the portion of the liquid, which is thus forced into the lower end of the tube, will not have time to rise to that height before it will be met by steam, and obliged to return back into the vessel.

There will be no difficulty in arranging the apparatus in such a manner, as effectually to prevent the liquid to be heated from being forced backwards into the steam boiler; and, when this is done, and some other necessary precautions to prevent accidents are taken, steam may be employed, with great advantage, for heating liquids; and for keeping them hot, in a variety of cases, in which fire, applied immediately to the bottoms of the containing vessels, is now used.

In dying, for instance, in bleaching, and in brewing, and in the processes of many other

arts and manufactures, the adoption of this method of applying heat would be attended, not only with a great saving of labour, and of fuel, but also of a considerable saving of expence in the purchase and repairs of boilers, and of other expensive machinery: for, when steam is used instead of fire, for heating their contents, boilers may be made extremely thin and light; and, as they may easily be supported and strengthened by hoops and braces of iron, and other cheap materials, they will cost but little, and seldom stand in need of repairs.

To these advantages we may add others of still greater importance: Boilers intended to be heated in this manner may, without the smallest difficulty, be placed in any part of a room—at any distance from the fire;—and in situations in which they may be approached freely on every side. They may moreover easily be so surrounded with wood, or with other cheap substances, which form warm covering, as most completely to confine the heat within them, and prevent its escape. The tubes by which the steam is brought from the principal boiler (which tubes may conveniently be suspended just below the ceiling of the room) may, in like manner, be covered, so as almost entirely to prevent all loss of heat by the surfaces of them; and this, to whatever distances they may be made to extend.

In suspending these steam-tubes, care must, however, be taken, to lay them in a situation, *not perfectly*

*feetly horizontal*, under the ceiling, but to incline them at a small angle, making them rise gradually from their junction with the top of a large vertical steam-tube, which connects them with the steam, boiler, quite to their farthest extremities: for, when these tubes are so placed, it is evident that all the water formed in them, in consequence of the condensation of the steam in its passage through them, will run backwards, and fall into the boiler, instead of accumulating in them, and obstructing the passage of the steam, (which it would not fail to do were there any considerable bends or wavings, upwards and downwards, in these tubes) or, of running forward, and descending with the steam into the vessels containing the liquids to be heated;—which would happen if these tubes inclined *downwards*, instead of inclining upwards, as they recede from the boiler.

In order that clear and distinct ideas may be formed of the various parts of this apparatus,—even without figures,—I shall distinguish each part of it by a specific name: The vessel in which water is boiled in order to generate steam—and which, in its construction, may be made to resemble the boiler of a steam engine—I shall call the *steam-boiler*:—The vertical tube, which, rising up from the top of the boiler, conveys the steam into the tubes (nearly horizontal), which are suspended from the ceiling of the room, I shall call the *steam reservoir*:—To the horizontal tubes I shall give the name of *conductors of steam*:—and to the (smaller) tubes,

tubes, which, descending perpendicularly from these *horizontal conductors*, convey the steam to the liquids which are to be heated, I shall, exclusively, appropriate the appellation of *steam-tubes*.

The vessels in which the liquids that are to be heated are put, I shall call the *containing vessels*.—These vessels may be made of any form; and, in many cases, they may, without any inconvenience, be constructed of wood, or of other cheap materials, instead of being made of costly metals, by which means a very heavy expence may be avoided: or they may be merely pits sunk in the ground, and lined with stone, or with bricks.

Each *steam-tube* must descend *perpendicularly* from the *horizontal conductor* with which it is connected, to the level of the bottom of the *containing vessel* to which it belongs; and, moreover, must be furnished with a good cock, perfectly steam-tight; which may best be placed at the height of about six feet above the level of the floor of the room.

This *steam-tube* may either descend *within the vessel* to which it belongs, or *on the outside of it*, as shall be found most convenient. If it comes down on the outside of the vessel, it must enter it at its bottom, by a short horizontal bend: and its junction with the bottom of the vessel must be well secured, to prevent leakage. If it comes down into the vessel, on the inside of it, it must descend to the bottom of it, or at least to within a very few inches of the bottom of it; otherwise the  
liquid

liquid in the vessel will not be uniformly, or equally heated.

When the steam-tube is brought down on the inside of the containing vessel, it may either come down perpendicularly, and without touching the sides of it, or it may come down on one side of the vessel, and in contact with it.

When several steam-tubes, belonging to different containing vessels, are connected with one and the same horizontal steam conductor, the upper end of each of these tubes, instead of being simply attached by solder or by rivets to the under side of the conductor, must *enter*, at least one inch, *within the cavity of it*; otherwise the water resulting from a condensation of a part of the steam in the conductor, by the cold air which surrounds it, instead of finding its way back into the steam-boiler, will descend through the steam-tubes, and mix with the liquids in the vessels below; but when the open ends of these tubes *project upwards within the steam conductor*, though it be but to a small height above the level of its under side, it is evident that this accident cannot happen.

It is not necessary to observe here, that, in order that the ends of the steam-tubes may project *within the horizontal conductor*, the diameters of the former must be considerably less than the diameter of the latter.

To prevent the loss of heat arising from the cooling of the different tubes through which the  
steam



steam must pass in coming from the boiler, all those tubes should be well defended from the cold air of the atmosphere, by means of warm covering; but this may easily be done, and at a very trifling expence. The horizontal conductors may be enclosed within square wooden tubes, and surrounded on every side by charcoal dust,—fine sawdust,—or even by wool;—and the steam tubes, as well as the reservoir of steam, may be surrounded, first by three or four coatings of strong paper, firmly attached to them by paste, or glue, and covered with a coating of varnish; and then by a covering of thick coarse cloth. It will likewise be advisable to cover the horizontal conductors with several coatings of paper; for if the paper be put on to them while it is wet with the paste or glue, and if care be taken to put it on in long slips, or bands, wound regularly round the tube in a spiral line, from one end of it to the other, this covering will be useful, not only by confining more effectually the heat, but also, by adding very much to the strength of the tube, and rendering it unnecessary to employ thick and strong sheets of metal in the construction of it.

However extraordinary and incredible it may appear, I can assert it as a fact, which I have proved by repeated experiments, that if a hollow tube, constructed of sheet copper  $\frac{1}{20}$  of an inch in thickness, be covered by a coating only twice as thick, or  $\frac{1}{10}$  of an inch in thickness, formed of layers of strong paper, firmly attached to it by good glue,

the strength of the tube will be *more than doubled* by this covering.

I found by experiments, the most unexceptionable and decisive—of which I intend at some future period to give to the public a full and detailed account,—that the strength of paper is such, when several sheets of it are firmly attached together with glue, that a solid cylinder of this substance, the transverse section of which should amount to only one superficial inch, would sustain a weight of 30,000 lbs. avoirdupois, or above 13 tons, suspended to it, without being pulled asunder or broken.

The strength of hemp is still much greater, when it is pulled equally, in the direction of the length of its fibres. I found, from the results of my experiments with this substance, that a cylinder of the size above mentioned, composed of the straight fibres of hemp, glued together, would sustain 92,000 lbs. without being pulled asunder.

A cylinder, of equal dimensions, composed of the strongest iron I could ever meet with, would not sustain more than 66,000 lbs. weight; and the iron must be very good not to be pulled asunder with a weight equal to 55,000 lbs. avoirdupois.

I shall not, in this place, enlarge on the many advantages that may be derived from a knowledge of these curious facts. I have mentioned them now, in order that they may be known to the public; and that ingenious men, who have leisure for these researches, may be induced to turn their attention

tention to a subject, not only very interesting, on many accounts, but which promises to lead to most important improvements in mechanics.

I cannot return from this digression without just mentioning one or two results of my experimental investigations relative to the force of cohesion, or strength of bodies, which, certainly, are well calculated to excite the curiosity of men of science.

The strength of bodies of different sizes, *similar in form*, and composed of the *same substance*,—or the forces by which they resist being pulled asunder by weight suspended to them, and acting in the direction of their lengths—are *not in the simple ratio of the areas of their transverse sections*, or of their *fractures*;—but in a higher ratio—and this ratio is different in different substances.

The *form* of a body has a considerable influence on its strength, *even when it is pulled in the direction of its length*.

All bodies, even the most brittle, appear to be *torn asunder*, or their particles separated, or fibres broken, *one after the other*; and hence it is evident, that that *form* must be most favourable to the strength of any given body, pulled in the direction of its length, which enables the greatest number of its particles, or longitudinal fibres, to be separated to the greatest possible distance—short of that at which the force of cohesion is overcome,—before *any of them* have been forced *beyond* that limit.

It is more than probable that the apparent strength of different substances depends much more on the number of their particles that come into action before any of them are forced beyond the limits of the attraction of cohesion, than on any specific difference in the intensity of that force in those substances.

But to return to the subject more immediately under consideration.—As it is essential that the steam employed in heating liquids, in the manner before described, should enter the containing vessel at, or very near, its bottom, it is evident that this steam must be sufficiently strong, or elastic, to overcome, not only the pressure of the atmosphere, but also the additional pressure of the superincumbent liquid in the vessel; the steam boiler must, therefore, be made strong enough to confine the steam, when its elasticity is so much increased by means of additional heat, as to enable it to overcome that resistance. This increase of the elastic force of the steam need not, however, in any case, exceed a pressure of five or six pounds upon a square inch of the boiler, or *one third part*, or *one half*, of an atmosphere.

It is not necessary for me to observe here, that in this, and also in all other cases, where steam is used as a vehicle for conveying heat from one place to another, it is indispensably necessary to provide *safety-valves* of two kinds;—the one for letting a part of the steam escape, when, on the fire being suddenly increased, the steam becomes  
so

so strong as to expose the boiler to the danger of being burst by it \*;—the other for admitting air into the boiler, when, in consequence of the diminution of the heat, the steam in the boiler is condensed, and a vacuum is formed in it; and when, without this valve, there would be danger, either of the sides of the boiler being crushed, and forced inwards by the pressure of the atmosphere from without; or of the liquid in the containing vessels being forced upwards into the horizontal steam-conductors, and from thence into the steam-boiler. The last-mentioned accident, however, cannot happen, unless the cocks in some of the steam tubes are left open.—The two valves effectually prevent all accidents.

The reader will, no doubt, be more disposed to pay attention to what has here been advanced on this interesting subject, when he is informed that the proposed scheme has already been executed on a very large scale, and with complete success; and that the above details are little more than exact descriptions of what actually exists.

A great mercantile and manufacturing house at Leeds, that of Messrs. Gott, and Co. had the courage, notwithstanding the mortifying prediction of all their neighbours, and the ridicule with

\* The steam which escapes out of the boiler through the safety-valve may very easily be made to pass into the reservoir of water which feeds the boiler, and be condensed there; which will warm that water, and by that means save a quantity of heat, which otherwise would escape into the atmosphere, and be lost.



which the scheme was attempted to be treated, to erect a *dying-house*, on a very large scale indeed, on the principles here described and recommended.

On my visit to Leeds in the summer of the year 1800, I waited on Mr. Gott, who was then mayor of the town, and who received me with great politeness, and showed me the cloth-halls, and other curiosities of the place: but nothing he showed me interested me half so much as his own truly noble manufactory of superfine woollen cloths.

I had seen few manufactories so extensive, and none so complete in all its parts. It was burnt to the ground the year before, and had just been rebuilt, on a larger scale; and with great improvements in almost every one of its details.

The reader may easily conceive that I felt no small degree of satisfaction, on going into the dying-house, to find it fitted up on principles which I had some share in bringing into repute, and which Mr. Gott told me he had adopted in consequence of the information he had acquired in the perusal of my *Seventh Essay*.

He assured me that the experiment had answered, even far beyond his most sanguine expectations; and, as a strong proof of the utility of the plan, he informed me, that his next door neighbour, who is a dyer by profession, and who, at first, was strongly prejudiced against these innovations, had adopted them, and is now convinced that they are real improvements.

Mr.

Mr. Gott assured me, that he had no doubt but they would be adopted by every dyer in Great Britain in the course of a very few years.

The dying-house of Messrs. Gott and Co. which is situated on the ground floor of the principal building of the manufactory, is very spacious, and contains a great number of coppers, of different sizes; and as these vessels, some of which are very large, are distributed about promiscuously, and apparently without any order in their arrangement, in two spacious rooms,—each copper appearing to be insulated, and to have no connection whatever with the others,—all of them together form a very singular appearance.

The rooms are paved with flat stones, and the the brims of all the coppers—great and small—are placed at the same height (about three feet) above the pavement. Some of these coppers contain upwards of 1800 gallons; and they are all heated by steam from *one steam-boiler*, which is situated in a corner of one of the rooms, almost out of sight.

The horizontal tubes, which serve to conduct the steam from the boiler to the coppers, are suspended just below the ceiling of the rooms: they are made—some of lead—and some of cast-iron; and are from four to five inches in diameter; but when I saw them, they were naked, or without any covering to confine the heat. On my observing to Mr. Gott that coverings for them would be useful, he told me that it was intended

that they should be covered, and that coverings would be provided for them.

The vertical *steam-tubes*, by which the steam passes down from the horizontal *steam-conductors* into the coppers, are all constructed of lead; and are from  $\frac{1}{4}$  of an inch to  $2\frac{1}{2}$  inches in diameter; being made larger or smaller according to the sizes of the coppers to which they belong. These steam-tubes all pass down on the *outsides* of their coppers, and enter them horizontal at the level of their bottoms. Each copper is furnished with a brass cock, for letting off its contents; and it is filled with water from a cistern at a distance, which is brought to it by a leaden pipe. The coppers are all surrounded by thin circular brick-walls, which serve not only to support the coppers, but also to confine the heat.

The rapidity with which these coppers are heated, by means of steam, is truly astonishing. Mr. Gott assured me, that one of the largest of them, containing upwards 1800 gallons, when filled with cold water from the cistern, requires no more than *half an hour* to heat it till it actually boils!—By the greatest fire that could be made under such a copper, it would hardly be possible make it boil in less than an hour.

It is easy to perceive that the *saving of time*, which will result from the adoption of this new mode of applying heat, will be very great;—and it is likewise evident that it may be increased, almost without limitation, merely by augmenting

the diameter of the steam-tube : Care must, however, be taken, that the boiler be sufficiently large to furnish the quantities of steam required.—The *saving of fuel* will also be very considerable : Mr. Gott informed me, that, from the best calculation he had been able to make, it would amount to near two-thirds of the quantity formerly expended, when each copper was heated by a separate fire.

But these savings are far from being the only advantages that will be derived from the introduction of these improvements in the management of heat : There is one, of great importance indeed—not yet mentioned—which alone would be sufficient to recommend the very general adoption of them.—As the heat communicated by steam can never exceed the mean temperature of boiling water by more than a very few degrees, the substances exposed to it can never be injured by it.

In many arts and manufactures this circumstance will be productive of great advantages, but in none will its utility be more *apparent* than in cookery ; and especially in public kitchens,—where great quantities of food are prepared in large boilers ;—for, when the heat is conveyed in this manner, all the labour now employed in stirring about the contents of those boilers, to prevent the victuals from being spoiled by burning to the bottoms of them, will be unnecessary ; and the loss of heat occasioned by this stirring, prevented ;—and, instead of expensive coppers, or metallic boilers, which

which are sometimes unwholesome, and always difficult to be kept clean, and often stand in need of repairs,—common wooden tubs may, with great advantage, be used as culinary vessels; and their contents may be heated by *portable fire-places*, by means of steam-boilers attached to them.

As these portable fireplaces and their steam, boilers may, without the smallest inconvenience, be made of such weight, form, and dimensions, as to be easily transported from one place to another, by two men; and be carried through a door-way of the common width;—with this machinery, and the steam-tubes belonging to it, and a few wooden tubs, a complete public kitchen, for supplying the poor, and others, with soups, and also with puddings, vegetables, meat, and all other kinds of food prepared by *boiling*, might be established in half an hour, in any room, in which there is a chimney (by which the smoke from the portable fire-place can be carried off); and, when the room should be no longer wanted as a kitchen, it might, in a few minutes, be cleared of all this culinary apparatus, and made ready to be used for any other purpose.

This method of conveying heat is peculiarly well adapted for heating baths: It is likewise highly probable that it would be found useful in the bleaching business, and in washing linen. It would also be very useful in all cases where it is required to keep any liquid at about the boiling point for a long time without making it boil; for the quantity  
of



of heat admitted may be very nicely regulated by means of the brass cock belonging to the steam-tube. Mr. Gott showed me a boiler in which shreds of skins were digesting in order to make glue, which was heated in this manner; and in which the heat was so regulated, that, although the liquid never actually boiled, it always appeared to be upon the very point of beginning to boil.

This temperature had been found to be best calculated for making good glue. Had any other *lower* temperature been found to answer better, it might have been kept up with the same ease, and with equal precision, by regulating properly the quantity of steam admitted.

I need not say how much this country is obliged to Mr. Gott, and his worthy colleagues.—To the spirited exertions of such men—who abound in no other country—we owe one of the proudest distinctions of our national character;—that of being *an enlightened and an enterprising people*.

In fitting up the great kitchen at the house of the Royal Institution, I availed myself of that opportunity to show, in a variety of different ways, how steam may be usefully employed in heating liquids.

On one side of the room, opposite to the fire-place, and where there is no appearance of any chimney, I fitted up a steam-boiler, of cast-iron, which, to confine the heat, is so compleatly covered up by the brick-work in which it is set, that no part of it is seen. This boiler is supplied with

water from a reservoir at a distance (which is not seen) and by means of a cock, which is regulated by an hollow floating ball of thin copper, the water in the boiler always stands at the same height, or level.

The steam from this boiler rises up perpendicularly in a tin tube, which is concealed in a square wooden tube, by the side of the wall of the room, and enters an horizontal tin tube (concealed in the same manner) which lies against the wall, and just under the ceiling.

From this horizontal steam *conductor* three tubes descend, perpendicularly (concealed in three square wooden tubes) and enter three different kitchen boilers (on a level with their bottoms) which are set in brick work, against the same side of the room where the steam boiler is situated.

As each of these boilers has its separate fireplace, properly furnished with a good double door, and register ash-pit door; and also with a canal, furnished with a damper, for carrying off the smoke; either of these three boilers may be used for cooking, either with a fire made under it, or with steam brought into it, from the neighbouring steam-boiler.

The object I had principally in view in this arrangement was to shew, in the most striking and convincing manner, that all the different processes of cookery, which are performed by boiling, such as boiling meat and vegetables *in boiling water*—making soups—stewing, &c. may, in all cases, be performed

performed quite as well, and in many much better, by heating the liquid which is to be boiled, and keeping it boiling, by admitting hot steam *into it*, than by making a fire *under it*.

By using one of these boilers *alternately* in these two ways, on different days, in preparing the same kind of food, I concluded that all doubts on this subject would be most effectually removed.

To exhibit in a manner still more striking the application of steam to the boiling of liquids for culinary purposes, the following arrangement has been made, and completed.—An horizontal steam-conductor (concealed in a square wooden tube) communicating, at right angles, with the steam conductor before described, passes, just below the ceiling, from the middle of one side of the room, to the middle of the ceiling; and ends in a vessel, in the form of a flat drum, about ten inches in diameter, and five inches high, which is attached to the ceiling, perpendicularly over the center of a large table, which is placed in the middle of the room.

On the outside of this drum, or short hollow cylinder (which is made of tin, and covered with wood, to confine the heat) there are, at equal distances, four projecting horizontal tubes, each about one inch in diameter, and two inches long, which communicate with the inside of the drum. These tubes all point to the same center, namely, to the center of the drum.

To each of these short horizontal tubes, there is  
fixed

fixed one end of a steam tube composed of three pieces, fixed to each other, and moveable, by means of joints, which are all steam-tight.

The end of this compound flexible steam-tube is united to the end of the short tube, which projects from the side of the drum, by means of a steam-joint, in such a manner, that the steam-tube, attached to the drum, and communicating with it, may either be folded up, in joints, or lengths, just under the ceiling, or it may be made to hang down from the end of the short tube to which it is attached.—The lower joint, or rather division of this flexible steam-tube, which reaches nearly to the top of the table, is furnished with a brass cock, by which it is occasionally closed; or rather, by which it is always kept closed when it is not in actual use.

I might perhaps spare myself the trouble of describing the manner in which this culinary steam apparatus is used, as the imagination of the reader will most probably have run before me. I shall, however, just mention a very striking and pleasing manner of making the experiment, in which the action of this machinery will be exhibited to great advantage.

If the cold water, which is to be heated, and made to boil by the steam, is put into a large glass bowl, or jar; on plunging the lower end of one of the flexible steam-tubes into the water, and then opening the steam-cock, the agitation into which the water in the glass vessel will be thrown will be visible

visible through the glass; and the passage of the steam, in its elastic form, upwards, through the water into the air, *after the water has become boiling hot*, and not before, will be an instructive, as well as an amusing experiment.

Those of the flexible steam-tubes which are not in actual use, are kept so folded up, (in order to their being out of the way) that their two upper divisions, lying by the side of each other, in an horizontal position, are just under the ceiling of the room; while their lower divisions hang vertically downwards, pointing towards the table.

In order that the kitchen may not be filled with steam when any of the boilers on the side of the room are used, their covers are all furnished with steam-tubes, which, communicating by a particular contrivance, with an horizontal steam-tube, which lies immediately over these boilers just under the ceiling, and which, by passing through the wall of the building, opens into the external air, all the waste steam from these boilers is carried out of the kitchen.

Before I conclude this Essay, I shall add a few observations concerning an application of steam, which has not yet, to my knowledge, been made, but which there is much reason to think would turn out to be of very great importance indeed in many cases.—This is the employing of it for communicating *degrees of heat above that of boiling water.*

I was led to meditate on this subject by an account I received, not long ago, of some very surprising



prizing effects which were produced in bleaching, by using the steam of a very strong solution of potash for boiling the linen, instead of water; as I was confident that no part of the alkali could possibly be evaporated in this process, I could not account in any other way for the effects produced, but by supposing them to have been owing to the *high temperature* of the steam which rose from this strong lixivium: and, as steam, at a high temperature, might easily be procured, and applied to the linen, without the use of the alkali, I thought it would be worth while to try the experiment with hot steam, produced from pure water. I mentioned this idea to Mr. Duffin, secretary of the Linen Board in Ireland, who is himself concerned, in an extensive way, in the bleaching business, who has promised to make some experiments on this subject, which I took the liberty to point out, and to recommend to him, as being likely to lead to interesting results.

Meditating on the various uses to which *hot*, or (which is the same thing) *strong steam* might be applied, it occurred to me that it would probably be found to be extremely useful in *allum works*, for concentrating the liquor from which allum is crystalized. There are, as is well known, many difficulties attending the evaporation and concentration of that liquid; and it is never done without occasioning a very considerable expence, as well for fuel, of which large quantities are consumed, as  
also

also on account of the frequent repairs of the pans, which are found to be necessary.

Most, if not all these difficulties, might, I think, be avoided, by introducing strong steam into this liquor, instead of concentrating it over a fire. This concentration might certainly be effected as well, and probably better, and more expeditiously, by using hot steam, than by the immediate use of the heat of a fire; and the expence occasioned by the wear and tear of the apparatus would, no doubt, be much less in the former case than in the latter: and, if it should be found (which is not unlikely) that *some certain temperature* is more advantageous in this process than any other, *that temperature*, when once discovered, may be preserved, with very little variation, when steam is used (by placing a valve, loaded with a proper weight, in the steam-tube, and obliging the steam to lift that valve, in order to pass through the tube); but there is no possibility of regulating, with any precision, the degrees of heat employed, when liquids are evaporated in boilers over a fire.

I would just point out one more application of steam, which, if I am not much mistaken, will turn out to be very advantageous indeed, in many respects;—it may be employed in heating the fermented liquor from which ardent spirits are distilled.

A proposal for introducing watery vapour into a liquor from which pure ardent spirits are to be distilled, or forced away by heat, will, no doubt, be thought very extraordinary by those who have

never meditated on the subject ; but when they shall have considered it with attention, they will find reason to conclude that this method of distilling bids fair to be very useful. The saving of expence for coppers, and other costly utensils and machinery, would be very considerable ; and the danger of the flavour of the spirits being injured by the burning of the liquor to the sides of the copper, would be entirely removed.

Steam has already been introduced, in several great manufactories in this country, into *drying-houses*, and employed, with the best effects, for heating and drying linen, cotton, and woollen goods, after they have been washed :—it has also been used in the *drying-rooms* of several paper manufactories. When it is used for any of these purposes, it should be introduced into tubes of large diameter, or into several smaller tubes, constructed of very thin sheet copper (or into any other metallic tubes, *having a large surface*, that would be cheaper) and these tubes should be placed nearly in an horizontal position in the *lower part* of the drying-room, and *under* the goods that are to be dried ; and, (in order to economize the heat as much as possible) the water resulting from the condensation of the steam in the steam-tubes, should be conducted, by small tubes, well covered with warm covering, into the reservoir which feeds the steam-boiler.

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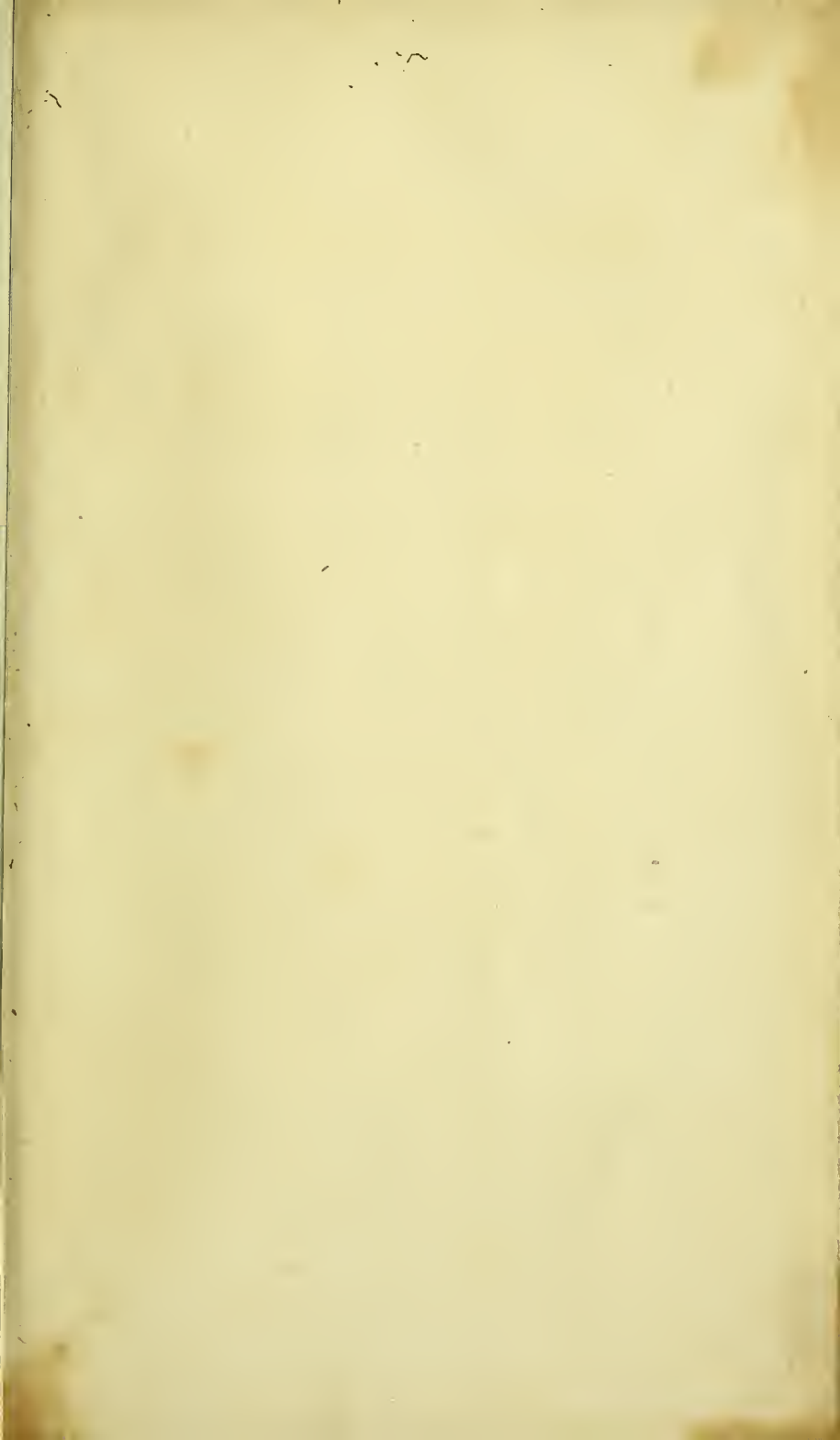
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